Comparative effectiveness of encounter decision aids for early stage breast cancer across socioeconomic strata

Trial Protocol

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List of Abbreviations

HIPAA	Health Insurance Portability and Accountability Act
NYU	New York University
PCORI	Patient Centered Outcomes Research Institute
SDM	Shared Decision Making
SES	Socioeconomic status
CITI	Collaborative Institutional Training Initiative
PI	Principal Investigator
BCS	Breast-Conserving Surgery
DQI	Decision Quality Instrument
CBPR	Community-Based Participatory Research
PRO	Patient Reported Outcome
DSMB	Data & Safety Monitoring Board
REDCap	Research Electronic Data Capture
TSG	Trial Steering Group
NH	New Hampshire
MO	Missouri
NY	New York
OOP	Out-of-Pocket

General Information

This document provides details regarding the setup, conduct, and analysis of the Patient Centered Outcomes Research Institute (PCORI) funded study, “Comparative effectiveness of encounter decision aids for early stage breast cancer across socioeconomic strata.”

Compliance

This study will be conducted in compliance with the The Health Insurance Portability and Accountability Act (HIPAA), the Security Breach Notification Rule[1], and the principles of the declaration of Helsinki, (1964) as revised in Tokyo (2004)[2].

Key Study Personnel

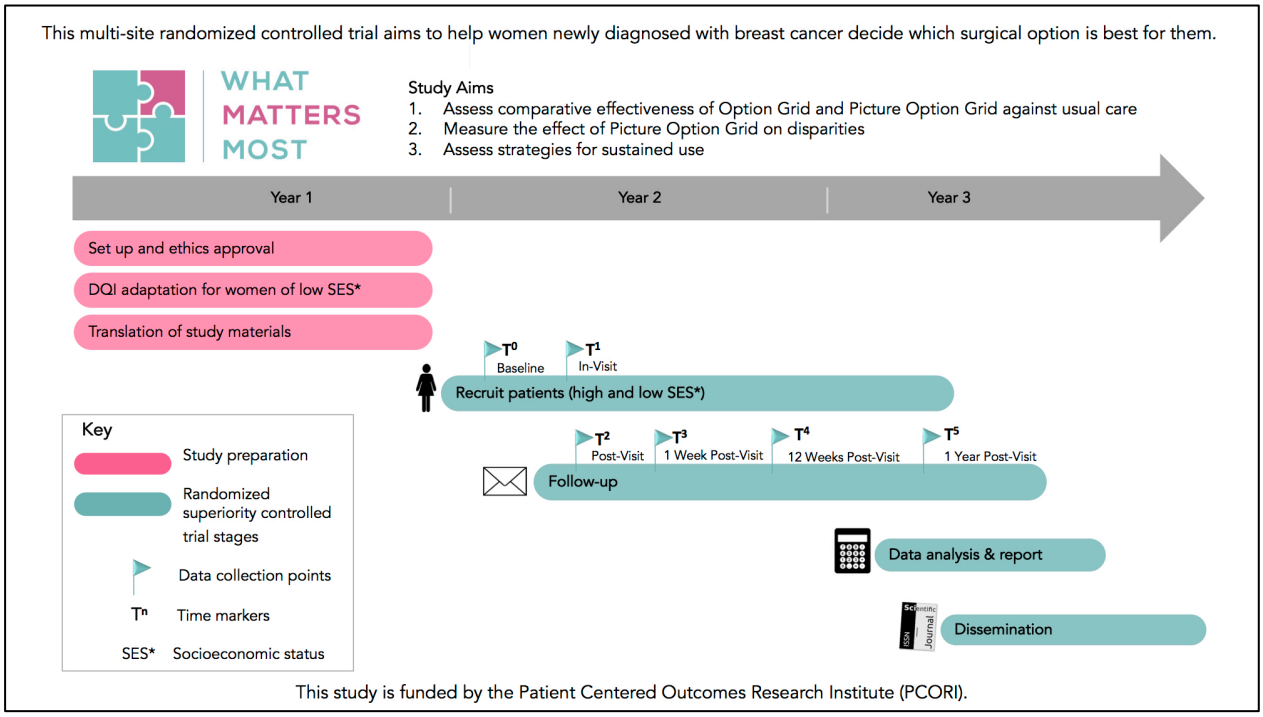
Principal Investigator (PI): Dr. Marie-Anne Durand
Co-Principal Investigator: Dr. Glyn Elwyn
Co-Investigator (New York University School of Medicine Site PI): Dr. Shubhada Dhage
Co-Investigator (Washington University in Saint Louis Site PI): Dr. Mary Politi
Co-Investigator (Montefiore Medical Center Site PI): Dr. Katie Weichman
Co-Investigator: Dr. Julie Margenthaler
Co-Investigator: Dr. A. James O'Malley
Co-Investigator: Dr. Kari Rosenkranz
Co-Investigator: Dr. Karen Sepucha
Co-Investigator: Dr. Anna Tosteson
Co-Investigator: Dr. Dale Vidal
Consultant: Dr. Sanja Percac-Lima
Consultant: Dr. Robert Volk
Consultant: Dr. Elissa Ozanne
Patient Partner: Eloise Crayton
Patient Partner: Sherrill Jackson
Patient Partner: Linda Walling
Patient Partner: Ann Bradley

Signatures

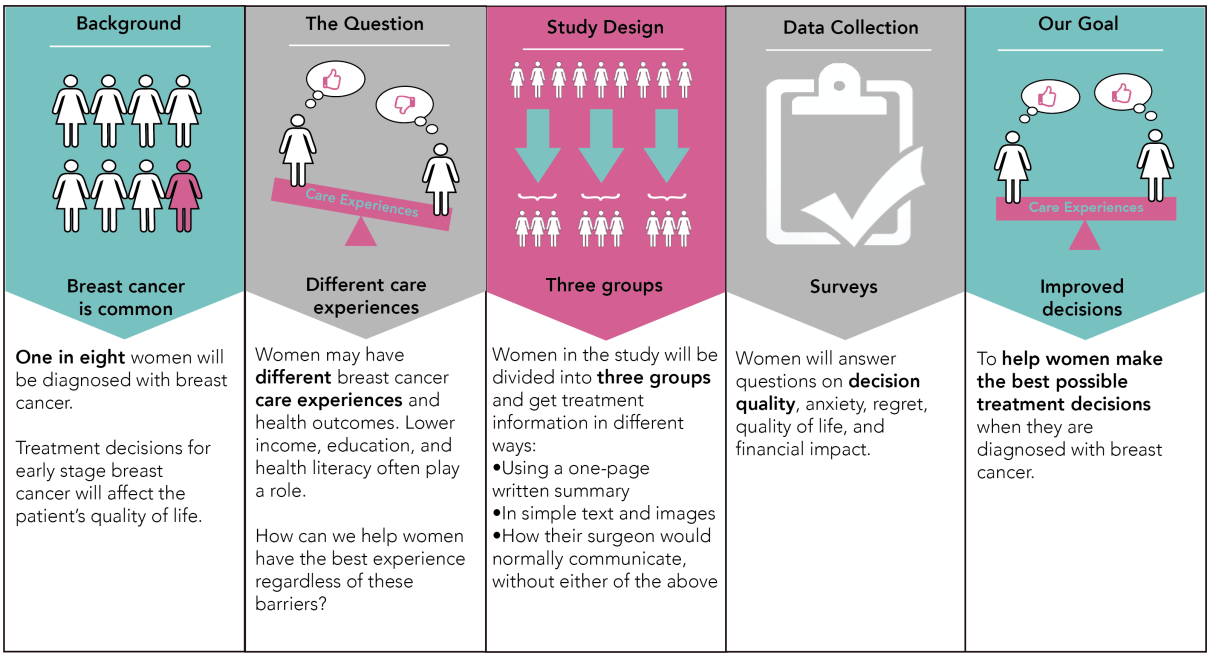
The Contact Principal Investigator (M-A Durand), and Principal Investigators (PI) at each site have discussed this protocol. The investigators agree to perform the investigations and to abide by this protocol except in case of medical emergency or where departures from it are mutually agreed in writing.

Name: ……	Role: Contact PI
Signature: ……	Date: ……
Name: ……	Role: Site PI (NYUSOM)
Signature: ……	Date: ……
Name: ……	Role: Site PI (WUSTL)
Signature: ……	Date: ……
Name: ……	Role: Site PI (Montefiore)
Signature: ……	Date: ……

1 Protocol Summary



1.1 Lay Summary



Nearly one in eight women will be diagnosed with breast cancer. This diagnosis is traumatic and life changing for all women. Breast cancer care, breast cancer treatments, and the effect on women's lives are often worse for women of lower socioeconomic status (SES) and lower health literacy. They are more likely than women of higher SES to experience lower knowledge of breast cancer surgery, higher uptake of mastectomy, increased decision regret, worse patient-centered health outcomes, and poorer care. These disparities are differences that are unlikely to be explained by the patient's preferences but are partly explained by difficulties

accessing and understanding information, doctor-patient communication, lack of involvement in treatment decisions, etc.

We aim to understand how best to help women of lower SES make high quality decisions about early stage breast cancer treatments. Their choice should ideally be informed by adequate knowledge and aligned with their values and preferences. We will be comparing two effective patient decision aids used in the health care visit (Option Grid and Picture Option Grid) to usual care in women of higher SES and lower SES. We hope that the decision aids help all women (irrespective of SES) achieve higher decision quality and a treatment choice that is informed by their knowledge and preferences. In addition, we hope to demonstrate that women who have used the decision aids are meaningfully involved in treatment decisions, have lower anxiety, experience less decision regret and higher quality of life, and perceive more coordination and integration of care compared to women who receive usual care. We also hope to show that the Picture Option Grid can reduce disparities in decision-making and treatment choice between women of higher and lower SES.

This project is important to patients because making the wrong treatment decision for early stage breast cancer will have serious consequences on the patient's life and quality of life. This project is likely to change the way patients and clinicians make decisions about breast cancer surgery, regardless of SES.

Patient and stakeholder partner involvement is an essential aspect of this study. Patient and stakeholder partners have been involved in designing the study, identifying the research questions, and choosing the outcomes to be measured. They will also be involved in conducting the study and monitoring progress and risks. At each site, one patient associate (a former breast cancer patient) will recruit patients with a research assistant and will collect data and contribute to data analysis. The patient associates' continuous input in designing, planning, conducting, and managing the study will maximize the success of recruitment and data collection procedures as well as the applicability and implementation potential of the findings and intervention(s).

1.2 Scientific Abstract

Background: Breast cancer is the most commonly diagnosed malignancy in women. Despite improvements in survival, women of lower SES diagnosed with early stage breast cancer (compared to women of higher SES):
- Continue to experience poorer doctor-patient communication, lower satisfaction with surgery and decision-making, and higher decision regret;
- More often play a passive role in decision-making;
- Are less likely to undergo breast-conserving surgery (BCS);
- Are less likely to receive optimal care.

Those differences are disparities that predominantly affect women of low SES with early stage breast cancer, irrespective of race or ethnicity. For early stage breast cancer, low SES is a stronger predictor of poorer outcomes, treatment received, and death than race or ethnicity. We define low SES as having a lower income and uninsured or state-insured status. We will

not use educational attainment as part of the inclusion criteria but will examine it using multiple informants analysis as an indicator of lower SES (see Section 4.7 Statistical Analysis).

BCS is the recommended treatment for early stage breast cancer (stages I to IIIA) although research confirms equivalent survival between mastectomy and BCS. Both options are offered yet have distinct harms and benefits, valued differently by patients. Research shows that women of low SES are not usually involved in an informed, patient-centered dialogue about surgery choice. There is no evidence that women of low SES have distinct preferences that explain a lower uptake of BCS and limited engagement in decision-making. Further, communication strategies are not typically adapted to women of low SES and low health literacy. Most patient decision aids for breast cancer have been designed for people at high literacy levels and have low accessibility and readability. It is critical to determine how to effectively support women of low SES in making informed breast cancer surgery choices. There is some evidence that simpler, shorter decision aids delivered by clinicians in the clinical encounter (encounter decision aids) may be more beneficial to underserved patients and reduce disparities, but further research is needed.

Objectives: First, we will assess the comparative effectiveness of two encounter decision aids (Option Grid and Picture Option Grid) against usual care on a patient-reported measure of decision quality (primary outcome), shared decision-making, treatment choice, and other secondary outcomes across socioeconomic strata (Aim 1). Second, we aim to explore the effect of the Picture Option Grid on disparities in decision-making (decision quality, knowledge, and shared decision-making) and treatment choice, as well as mediation and moderation effects (Aim 2). Third, in order to maximize the implementation potential, we will explore strategies that promote the encounter decision aids' sustained use and dissemination using a theoretical implementation model (Aim 3).

Design: We will conduct a three-arm, multi-site randomized controlled superiority trial with stratification by SES (Aims 1 and 2) and randomization at the clinician level. Six hundred (half higher SES and half lower SES) will be recruited from four large cancer centers. In preparation for the trial (Year 01), we will conduct semi-structured interviews with women of lower SES who have completed treatment for early stage breast cancer at all four participating sites, to adapt the "What Matters Most to You" subscale of the Decision Quality Instrument (DQI) for women of lower SES. Lastly, we will use interviews, field-notes, and observations to explore strategies that promote the interventions' sustained use and dissemination using the Normalization Process Theory (Aim 3). Community-Based Participatory Research (CBPR) methods will be used throughout the trial with continuous patient and stakeholder involvement.

Population: We will include women at least 18 years of age with a confirmed diagnosis of early stage breast cancer (I to IIIA) from both higher and lower SES, provided they speak English, Spanish, or Mandarin Chinese.

Interventions: Both interventions have been developed, tested, and shown to be effective. The Option Grid (intervention 1) is a one-page, evidence-based summary of available options presented in a tabular format, listing the trade-offs that patients normally consider when making breast cancer surgery decisions. The Picture Option Grid (intervention 2) uses the same evidence and tabular layout, but it is tailored to women of lower SES and low health literacy by having simpler text and images. Because patient decision aids are not routinely

available in real-world settings, usual care is a legitimate, reasonable comparator. Usual care will include the provision of routinely available informational resources about breast cancer.

Outcomes: The primary outcome measure is the 16-item validated Decision Quality Instrument. Secondary outcome measures include **Collabo**RATE, a three-item validated measure of shared decision-making, PROMIS, an eight-item validated anxiety short form, the validated five-item Decision Regret scale, Chew's validated one-item health literacy screening item, EQ-5D-5L, the validated 6-item quality of life measure, IntegRATE, a four-item measure of integration of health care delivery, four items from COST, an 11-item validated measure of financial toxicity, and one patient-reported measure of out-of-pocket expenses. All measures will be available in English, Spanish, and Mandarin Chinese. Observer OPTION[5] will be used to rate the level of shared decision-making in the clinical encounter in a subsample of consultations.

Analysis: We will use a regression framework (logistic regression, linear regression, mixed effect regression models, generalized estimating equations) and mediation analyses. We will use multiple informants' analysis to measure and examine SES and use multiple imputation to manage missing data. We will also perform heterogeneity of treatment effects analyses for SES, age, ethnicity, race, literacy, language, and study site.

2 Research Team

Marie-Anne Durand, BSc, MSc, MPhil, PhD, CPsychol (Principal Investigator) is an assistant professor at The Dartmouth Institute for Health Policy and Clinical Practice at the Geisel School of Medicine. She is the study contact PI and brings considerable experience of managing and leading research on the development and evaluation of interventions designed to improve patient engagement in health care and address healthcare disparities by targeting and empowering those who are underserved. She will be supported and mentored by Professor Glyn Elwyn. Drs. Durand and Elwyn will have shared decision-making authority and responsibility for planning, directing, and executing the proposed study. Dr. Durand, as contact PI, will be responsible for day-to-day logistical project management.

Glyn Elwyn, MD, MSc, FRCGP, PhD (co-Principal Investigator) is a tenured professor and physician-researcher at The Dartmouth Institute for Health Policy and Clinical Practice at the Geisel School of Medicine. As co-Principal Investigator, he brings substantial experience and internationally recognized expertise in research that seeks to understand how to effectively facilitate and implement SDM in routine clinical care.

Shubhada Dhage, MD, FACS (Site Principal Investigator) is a breast surgeon at Bellevue Hospital Center, associate director of Diversity in Cancer Research at New York University, and co-director at Bellevue Breast Clinic, New York, NY. She has interest and expertise in promoting informed choice in underserved and low literacy patients and reducing healthcare disparities in breast cancer care. She works with patients who originate from over 80 countries, and who, for the majority, do not speak English. Dr. Dhage is committed to facilitating the involvement of the entire breast care team in the randomized controlled trial and will coordinate the recruitment of patients at Bellevue Hospital Center and NYU Langone Medical Center.

Mary C. Politi, PhD (Site Principal Investigator) is a clinical psychologist and associate professor in the Division of Public Health Sciences, Department of Surgery at Washington

University School of Medicine, St. Louis, MO. Her research focuses on using systematic methods to help patients work through the uncertainties of health decisions through developing and evaluating patient decision tools, examining techniques to aid patient-clinician discussions about health decisions, and exploring ways to improve communication about risks. She also investigates the influence of numeracy and health literacy on medical decision-making. She will oversee the study design, recruitment activities, data analysis and dissemination of findings in the St. Louis region.

Katie E. Weichman, MD (Site Principal Investigator) is a breast reconstruction surgeon at the Montefiore Einstein Center for Cancer Care, Bronx, NY. She has interest and expertise in reducing health care disparities in breast cancer care and works with one of the most diverse populations in the country. Dr. Weichman is committed to facilitating the involvement of the entire breast care team in the trial and will coordinate the recruitment of patients and execution of the trial at Montefiore.

Julie Margenthaler, MD (Co-Investigator) is a professor of surgery at Washington University School of Medicine and the Director of the Joanne Knight Breast Health Center, St. Louis, MO. She has undergone fellowship training in breast diseases and breast surgical procedures with specific training and expertise in key research areas for this application. One of her clinical and research areas of interest has been in the investigation of breast cancer outcomes using large epidemiological databases. Dr. Margenthaler will facilitate recruitment in the Joanne Knight Breast Health Center and will work with Dr. Politi on dissemination of findings in the St. Louis region.

A. James O'Malley, PhD (Co-Investigator) is a professor of biostatistics at The Dartmouth Institute for Health Policy and Clinical Practice, Geisel School of Medicine. He will bring high-level expertise in statistical methodology and comparative effectiveness research and will provide leadership and guidance to the project manager in the development and maintenance of data management systems and the analysis of trial data.

Anna Tosteson, ScD (Co-Investigator) is the James J. Carroll Professor in Oncology and professor of Medicine, of Community and Family Medicine, and of The Dartmouth Institute for Health Policy and Clinical Practice at the Geisel School of Medicine. She co-directs the Cancer Control Program at the Norris Cotton Cancer Center (NCCC) and directs both NCCC's Office of Cancer Comparative Effectiveness Research (CER) and The Dartmouth Institute's CER Program. She will provide expertise on the impact of decision technologies on breast cancer care using her experience across the cancer spectrum, from screening to diagnosis to treatment.

Renata W. Yen, MPH (Project Coordinator) will provide operational management of the project and will be responsible for the following aspects of the trial: managing all trial set-up activities including site enrollment and IRB approval, trial registration, record keeping, data management and maintenance, coordinating patient and stakeholder engagement activities including facilitating and coordinating all research meetings and relationships with our patient and stakeholder partners (i.e., monthly research team meeting, quarterly CAB meetings, quarterly trial steering group meetings), monitoring progress at other sites, and ensuring adherence to the trial protocol across all four study sites.

Research Assistants. The individuals in this role will have responsibility for recruiting patients into the study at each study site and will work closely with the patient associate to consent and randomize patients, and ensure that all study procedures detailed in the trial protocol are duly followed. At DHMC, the research assistant will also assist the project manager in coordinating recruitment across all four sites. In Year 01, the research assistants will be responsible for recruiting 10 to 15 participants for the adaptation of the Decision Quality Instrument subscale and will conduct focus groups and interviews with the project manager. At DHMC, the research assistant will also be responsible for analyzing all data related to the DQI interviews and focus groups from all participating sites. In years 01, 02, and 03, the research assistants will focus on recruiting eligible patients for the randomized controlled trial at each site. In years 02 and 03, the research assistants will also conduct interviews with participants already enrolled in the trial and clinicians and other stakeholders at each site (Aim 3). At DHMC, the research assistant will also be responsible for the analysis of all Aim 3 data.

Sherrill Jackson (Patient Partner) is an African American who has 24 years of experience as a breast cancer survivor. She is a nurse practitioner and has devoted her time to working in medically underserved and uninsured committees. She was employed at two Federally Qualified Health Centers and established their radiology and mammography departments. Both facilities were located in “hotspots” of the city where African American women were presenting with late stage breast cancer. On-site screening resulted in an increased number of women screened and, over time, a reduction in the mortality rate. Sherrill is also the president and founder of The Breakfast Club, Inc. (founded in 1997), primarily serving African American women residing in North St. Louis and the surrounding county.

Eloise Crayton (Patient Partner) is an African American breast cancer caregiver and retired registered nurse who is committed to providing breast health education for low-income uninsured and underinsured women in the St. Louis, MO community. She is the program director and grant writer of The Breakfast Club, Inc., a group of breast cancer survivors and co-survivors focusing on reducing disparities in access to care and education in the community.

Linda Walling (Patient Partner) is a breast cancer survivor who received a diagnosis of early stage breast cancer four years ago. She wished she had received more evidence based information and decisional support from her breast care team in making the best decision for her and coping with the aftermath of breast cancer. She immediately accepted to become a patient partner and has been involved in all aspects of study design and planning. She will play a pivotal role in planning and executing the study.

Ann Bradley, BS, M.Ed. (Patient Partner and Patient Associate) is a registered nurse, who has recently retired and was previously working as a pastoral care coordinator and parish nurse of the Church of Christ at Dartmouth College, Hanover, NH. She has spent her professional life in the area of health education, health promotion, and health prevention. She is also a 23-year breast cancer survivor with a family history of breast cancer. Ann has already been involved in planning and designing the study and will continue to provide consultation as our patient partner. As the patient associate at Dartmouth, she will be responsible for helping with the recruitment of patients at NCCC and calling and reminding participants to complete all follow-up assessments. She will undergo relevant research training and will be trained and mentored in conducting research in clinical settings by the project coordinator.

Dale Collins Vidal, MD, MS (Stakeholder Partner) is the executive director of the Multi-Specialty Clinic (MSC) at Alice Peck Day Memorial Hospital, Lebanon, NH. She is a former professor of surgery at Geisel School of Medicine at Dartmouth and the former medical director of the Center for Shared Decision Making at Dartmouth-Hitchcock Medical Center. She led the efforts to promote and implement patient centered care at Dartmouth for the past six years. Dr. Vidal will be available to the project on an as needed basis.

Kari Rosenkranz, MD (Stakeholder Partner) is an associate professor of surgery and medical director of the Breast Cancer Program at Dartmouth-Hitchcock Medical Center. She will support the research team in recruiting patients and coordinating the randomized controlled trial at the Norris Cotton Cancer Center.

Sanja Percac-Lima, MD (Consultant) is a primary care physician at Massachusetts General Hospital Chelsea Community Health Care Center, Boston, MA, serving predominantly low-income, Latino, and immigrant populations. Her community work over the past 10 years has focused on improving equity in cancer care. She will be able to share the experience and perspectives of the low income, Latino communities she serves.

Robert J. Volk, PhD (Consultant) is a professor of health services research at the University of Texas MD Anderson Cancer Center in Houston, TX. He heads the Decision Support Lab and new Shared Decision Making Collaborative at MD Anderson. He will provide expertise on evaluating decision aids in patients of lower SES and lower literacy with the aim to reduce disparities. He developed the computerized decision aid for breast cancer, which was evaluated in women of low literacy and was the only decision aid for breast cancer (until the Picture Option Grid) to be targeted at underserved patients.

Karen Sepucha, PhD (Consultant) is the director of the Health Decision Sciences Center at Massachusetts General Hospital and assistant professor of medicine at Harvard Medical School. She will provide expertise in shared decision-making and measurement of decision quality and will advise the research team in adapting the Decision Quality Instrument (DQI) she developed for women of lower SES. She will also contribute to the analysis and interpretation of the adapted DQI.

Elissa M. Ozanne, PhD (Consultant) is an associate professor of population health science at University of Utah School of Medicine. She will provide substantial expertise of conducting research in breast cancer prevention and treatment as well as developing and evaluating decision aids in clinical trials.

3 Introduction

3.1 Background and Rationale

3.1.1 Impact of the Condition on the Health of Individuals and Populations

Breast cancer is the most commonly diagnosed malignancy and second leading cause of death in women[3,4]. Despite significant improvements in overall breast cancer survival, disparities persist in breast cancer treatment, communication in healthcare, long-term health outcomes and mortality[5,6]. Extensive evidence suggests that women of lower socioeconomic status (SES) diagnosed with early stage breast cancer have significantly poorer communication with their clinicians, lower knowledge of breast cancer surgery options, higher uptake of mastectomy, and worse cancer-related and patient-centered health outcomes compared to women of higher SES[5-13]. They also tend to receive breast cancer care that is inferior to that offered to women of higher SES and that deviates from established clinical guidelines (e.g., inconsistent use of radiation after breast conserving surgery; BCS)[6,12]. For the purpose of recruiting participants into the study, we define low SES as meeting the following two criteria: 1) 138% of the Federal Poverty Level or below and 2) uninsured or government-insured status (Medicaid or Medicare without supplemental insurance) or Accountable Care Act (ACA) marketplace plans[14,15]. Although educational attainment will not be used as part of the inclusion criteria, we will examine it using multiple informants analysis (see analysis section) and include it in our overall definition of lower SES. This definition is considered valid and relevant to the populations and outcomes under study[14,16].

SES-linked differences in early stage breast cancer care meet the Institute of Medicine (IOM)'s definition of a health service disparity: a difference in treatment or access not justified by differences in health status or preferences of the population groups[17]. There is no evidence that women of lower SES have distinct values and preferences that explain a significantly lower uptake of BCS and limited engagement in decision-making[6,10,11]. Differences in treatment received, doctor-patient communication, engagement in decision-making, and patient-centered health outcomes are disparities that predominantly affect women of low SES with early stage breast cancer, irrespective of race or ethnicity[5,11,18]. For early stage breast cancer, low SES is a stronger predictor of poor outcomes and treatment received than race or ethnicity[19,20].

Although BCS is the recommended treatment for early stage breast cancer (stages I to IIIA), research confirms equivalent survival between mastectomy and BCS[21-24]. Both options are offered routinely yet have distinct harms and benefits, which are valued differently by each patient[25]. In this context, patient preferences play an essential role in decision-making. According to the IOM, patient participation in decision-making should be promoted to improve the quality of health care, particularly for cancer care[26-30]. Our patient and stakeholder partners have emphasized the critical importance of supporting women in making high-quality breast cancer surgery decisions that are informed by adequate knowledge of breast cancer surgery and aligned with their values and preferences, regardless of SES and health literacy[31,32]. Only 44 to 51% of women with early stage breast cancer across all socioeconomic strata achieve the degree of participation in decision-making they desire[7,8,33-36]. Poor knowledge of breast cancer surgery is commonly reported[7,8,33-36]. Women of lower SES with early stage breast cancer tend to experience lower knowledge of breast cancer surgery, receive lower quality of care, play a passive role in decision-making, and have higher decision regret and lower

satisfaction with both surgery and decision-making[6,7,10,11,13]. Research also suggests that surgeons tend to spend more time communicating and engaging with more educated, affluent patients than with patients from lower socioeconomic strata[13]. A review demonstrated that patients of lower SES received significantly less information and socio-emotional support while experiencing less partnership building and a more directive approach than patients of higher SES[37].

3.1.2 Gaps in Evidence

Evidence Gap 1: How Can We Effectively Involve Women of Low SES in Breast Cancer Treatment Decisions?

The gap analysis identified a number of reviews and systematic reviews that have highlighted the association between SES, participation in decision-making, and breast cancer disparities[5,6,9,11,12,18]. Hurd's and Polacek's reviews demonstrate that healthcare disparities cannot be eliminated unless underserved patients are appropriately informed and supported in making informed breast cancer surgery decisions[6,11]. It remains unclear, however, how best to promote participation in decision-making, improve decision quality and knowledge, and reduce disparities across socioeconomic strata[11,38,39].

Limitations and Benefits of Decision Aids for Patients of Low SES. Patient decision aids provide evidence-based information about the harms and benefits of reasonable healthcare options to help individuals deliberate about their preferences[40]. For breast cancer, they have been shown to influence treatment decisions, increase BCS uptake, reduce decisional conflict, increase knowledge and satisfaction with the decision-making process, and in some instances, improve quality of life[32,41,42]. However, research confirms that most communication strategies (including decision aids) are designed for highly literate audiences, have poor accessibility and readability, and are not tailored to the needs of women of low SES and low health literacy[32,38,41,43-47]. Except for one computerized pre-encounter decision aid evaluated in low-literacy women, decision aids for breast cancer have always been evaluated in women of higher SES[39].

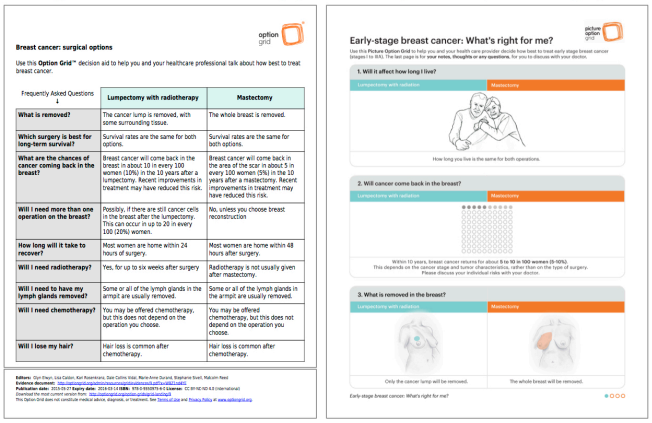
The PI's recent systematic review and meta-analysis indicate that decision aids significantly improved outcomes in underserved patients across disease areas[38]. Further, decision aids that were specifically tailored to underserved patients' needs appeared most effective. The narrative synthesis also suggested that disparities in knowledge, decisional conflict, uncertainty, and treatment preferences between disadvantaged and more privileged patients tended to disappear after using a decision aid. Underserved populations may therefore benefit more than advantaged groups from such interventions. Despite guidelines suggesting that decision aids use plain language and high readability[48], only a minority of decision aids use formats, layout, and content that are tailored to underserved patients' needs[38,44,45,48].

Encounter Decision Aids. To date, most decision aids have been introduced to patients *ahead* of clinical encounters (i.e., *pre-encounter* decision aids). They have focused on providing extensive information, often on the Internet, with poor accessibility and readability[44-47]. A systematic review of the readability and cultural sensitivity of web-based decision aids for cancer screening and treatment indicated that the vast majority of decision aids had low readability, complicated text, and a lack of cultural sensitivity[47]. Further, research has shown that although decision aids improve outcomes in controlled settings (with literate audiences),

their use in routine care remains rare because of resistance to implementation[49]. Clinicians argue that consultation time is limited and that complex pre-encounter decision aids are not designed for use in face-to-face encounters and disrupt workflows[49-55].

Shorter, simpler decision aids designed for use in clinical encounters—**encounter decision aids**—have received less attention than complex pre-encounter interventions[56]. An encounter decision aid (see Fig. 1) provides evidence-based information about significant harms and benefits of available options, is used in the clinic visit to facilitate the elicitation of patient values and preferences, and enables clinicians to tailor information to patients' needs and characteristics. They have been shown to increase patients' knowledge and participation in decision-making, to improve risk perception, and in some instances, to influence choice and improve adherence to treatments[57-62].

Fig 1. Encounter decision aids (Option Grid left; Picture Option Grid right)

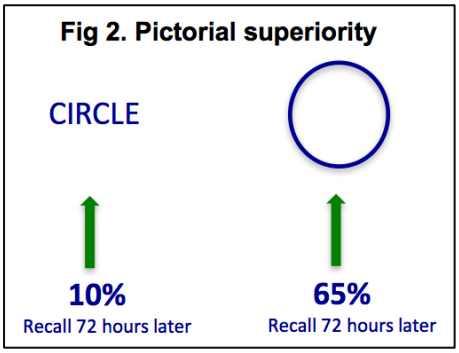


Recent evidence suggests that encounter decision aids are successfully used by clinicians, do not increase consultation time, and are becoming routinely adopted in usual care with integration in the electronic medical record[59,63-65]. They are showing great promise in overcoming common implementation challenges[63,64]. Politi (Co-Investigator) et al. suggest that underserved patients may prefer and benefit more from shorter, paper-based encounter decision aids than from complex, digital interventions[43]. However, **the effect of encounter decision aids in patients of low SES and low health literacy, and their potential to reduce disparities across socioeconomic strata, have never been evaluated.**

Tailoring Information to Reduce Disparities. When preparing information for low SES populations, it is imperative to recognize the barriers of limited health literacy and numeracy and to consider the use of images and easy-to-access formats such as paper-based interventions. Approximately 80 million US adults, many of whom have low SES, have low textual literacy and limited health literacy[66-68]. Healthcare professionals consider low health literacy a major barrier to involving patients in treatment decisions[44,69,70]. Patients' abilities to benefit from decision aids largely depend on their capacity to understand and use the interventions available to them[44,70]. Tailoring information to patients of low SES, who typically have low health literacy, is essential, though it is largely overlooked[11,45].

Our proposal seeks to challenge this highly textual literacy-assuming paradigm, by comparing a validated pictorial encounter decision aid (Picture Option Grid) to a validated text-based encounter decision aid (Option Grid) across socioeconomic strata.

Fig 2. Pictorial superiority



Pictorial superiority is defined as the tendency to understand and remember concrete items more

easily when they are presented as pictures rather than words (see Fig. 2)[71]. Pictures facilitate conceptual processing and demand less cognitive effort than words[72,73]. There is evidence of visual literacy in people of lower textual literacy[74]. Research confirms that the use of pictures promotes understanding, compliance, and recall associated with health education information[74,75]. No studies have yet to compare the effectiveness of a pictorial encounter decision aid to a text-based encounter decision aid across socioeconomic strata.

Evidence Gap 2: Why are Women of Low SES More Likely to Choose Mastectomy?

Treatment disparities in breast cancer care have been extensively examined[5,11,12,18,76-81]. The literature suggests that treatment disparities are associated with patient-, clinician-, and system-level factors[76,82]. The reasons women of low SES are more likely to choose mastectomy over BCS, however, are not well defined[10]. A higher uptake of mastectomy in this group would not be a concern, provided that this choice was the result of an informed preference and not a treatment disparity (i.e., treatment not justified by differences in health status or preferences of the population group). In fact, there is no evidence that women of low SES have clear preferences for mastectomy[10]. Based on extensive research evidence[5,6,9,11,12,18], we hypothesize that there is indeed a treatment disparity, which is strongly associated with less effective communication, lower knowledge of breast cancer surgery, and less participation in decision-making[10,11,13].

Other factors, such as limited financial resources and lack of insurance coverage, do not seem to predict decision-making for early stage breast cancer surgery[83]. There is no significant difference in monetary cost to patients between BCS and mastectomy, as BCS has higher short-term cost but lower long-term cost[84]. For many women of low SES, Medicare and other programs targeted at lower SES groups would cover the costs of either treatment, thus minimizing the impact of cost on decision-making. Other patient-level factors, such as childcare, transportation expenses, and other financial pressures (e.g., a need to return to work quickly) may be strong influences on the treatment choices of women of low SES irrespective of knowledge and participation in decision-making. The impact of these factors, however, is unclear and has not been demonstrated to date[85,86]. According to the literature, communication, accessible information, and participation in decision-making seem to play a significant (possibly the most significant) role in decision-making[5,6,9,11,12,18]. We hypothesize that encounter decision aids can address these issues and reduce disparities across socioeconomic strata. However, since it remains unclear how other factors (limited financial resources and other socioeconomic barriers) may affect decision-making, we will explore, in Aim 2, factors that may be mediating and moderating the intervention's effect[10,11,13,39].

3.2 Aims and Objectives

The three specific aims will be realized in the context of the logic model shown in Fig. 3:

AIM 1: Assess the comparative effectiveness of two effective encounter decision aids (Option Grid and Picture Option Grid) against usual care on shared decision-making (SDM), decision quality, treatment choice and other direct outcomes in women, and differentially by socioeconomic status (SES).

Hypothesis 1. The encounter decision aids will increase SDM in the clinic visit and improve decision quality, knowledge, and quality of life in women of higher and lower SES compared to usual care. We also anticipate that they will reduce decision regret and improve the perceived integration of healthcare delivery (see Fig. 3).

Hypothesis 2. The Picture Option Grid will be more effective than the Option Grid at improving primary and secondary outcomes in women of lower SES. There will be no difference between the effects of the two encounter decision aids in women of higher SES.

AIM 2: Measure the effect of the Picture Option Grid on disparities in decision-making (decision quality, knowledge, and SDM) and treatment choice, and conduct an exploratory analysis of the mediation and moderation effects.

Hypothesis 1. Compared to the Option Grid and usual care arms, the Picture Option Grid will reduce disparities in decision quality, knowledge and participation in shared decision-making between women of lower and higher SES. It is also likely to reduce disparities in treatment choice.

Hypothesis 2. The effect of the Picture Option Grid on treatment choice will be mediated by post-intervention knowledge, shared decision-making, and post-intervention values (reported in 'What Matters Most to You' subscale of DQI, e.g., keeping breast, removing breast to gain peace of mind, avoiding radiation, etc.) (see Fig. 4).

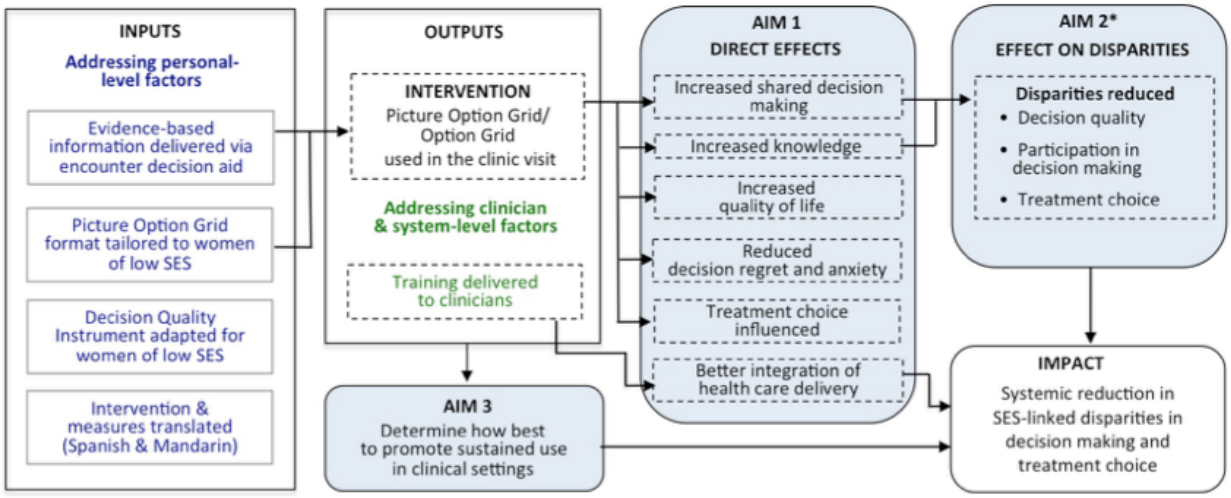
Hypothesis 3. For women of lower SES, socioeconomic barriers (e.g., resource constraints, as reported in the Decision Quality Instrument) will affect treatment choice and thereby moderate the intervention's effect.

AIM 3: Explore strategies that promote the encounter decision aids' sustained use and dissemination using a theoretical implementation model.

Hypothesis 1. Pre-visit planning, minimal clinician training, flexibility of use, and integration into the workflow and EMR will facilitate sustained use.

Hypothesis 2. Successful use by patients and their families will be determined by the perceived acceptability of the intervention and integration into workflows.

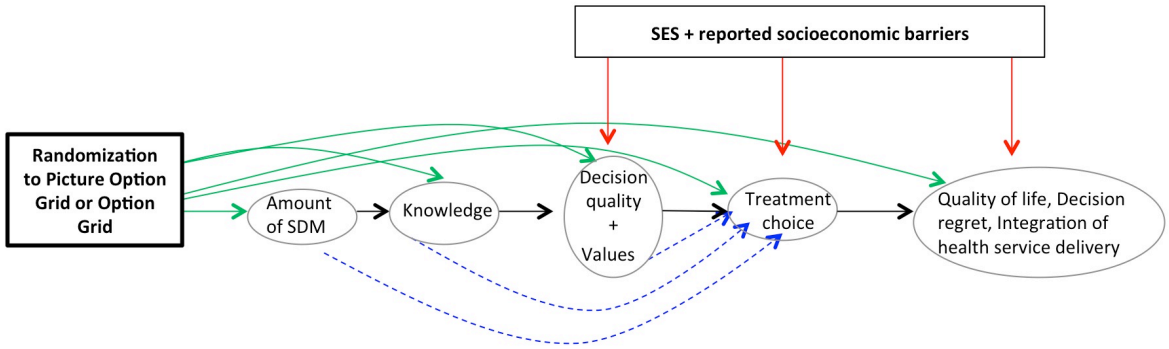
Fig. 3. Logic model of study



*** See Fig. 4 for mediation pathways.**

Legend: blue text = Personal level factors according to Cooper's framework, green text = Clinician & system level factors according to Cooper's framework, - - - - outline = outputs and outcomes of the randomized controlled trial

Fig. 4. Causal model for patients enrolled in the trial



Legend: Arrows depicted in green, red and blue represent causal relationships of one variable on another. The presence of green arrows will be examined in Aim 1. The presence of blue arrows (mediation effects) and red arrows (moderation effects) will be examined in an exploratory analysis in Aim 2.

4 Methods

4.1 Design

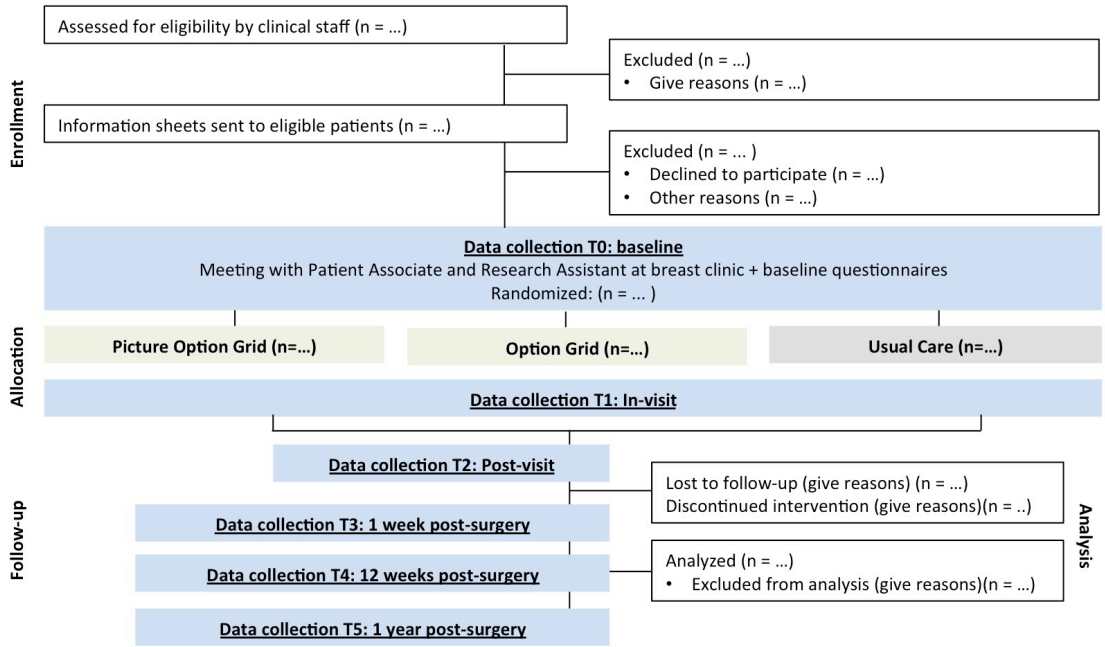
4.1.1 Design Overview

We will use a three-arm, multi-site randomized controlled superiority trial with stratification by SES and parallel design (Aims 1 and 2). One thousand one hundred patients (half higher SES and half lower SES) will be recruited from four large cancer centers over a 18-month period. Randomization will be at the clinician level, nested within study sites, and will involve data analyst blinding. In preparation for the trial, we will conduct semi-structured interviews in Year 1 with women of lower SES who have completed treatment for early stage breast cancer to adapt the "What Matters Most to You" subscale of the Decision Quality Instrument (DQI) for women of lower SES. For Aim 3, we will use interviews, field-notes, and observations to explore strategies that promote the encounter decision aids' sustained use and dissemination using a theoretical implementation model. See study Gantt Chart on page 46.

4.1.2 Randomized Controlled Superiority Trial (Aims 1 and 2)

According to Cooper et al., the most appropriate design for evaluating interventions that aim to eliminate disparities is a classic experimental design with random assignment to experimental and control groups, with measurements of key variables pre- and post-interventions[82]. We have thus chosen to conduct a three-arm, multi-site randomized controlled superiority trial with stratification by SES (high versus low) and randomization at the clinician level (nested within study sites) (see Fig. 5).

Fig. 5. CONSORT* Study Flow Diagram



*CONSORT stands for Consolidated Standards of Reporting Trials, as reported in the CONSORT statement[87].

At each site, we will use a cross-sectional study design and randomize participating clinicians (three to five clinicians per site) to one of three arms (Picture Option Grid, Option Grid, or usual

care). We will use an R script written by the study statistician to complete the surgeon randomization. At each site, patients who have given informed consent and are seeing one of the participating clinicians will be allocated to the clinician's corresponding arm (Picture Option Grid, Option Grid, or usual care). Approximately the same number of patients in each socioeconomic stratum will be allocated to each arm. We will monitor accrual within each arm for each socioeconomic stratum at each site to ensure that a similar number of patients in each socioeconomic stratum receive each treatment. The total number of patients recruited at each site will be allowed to vary.

4.1.3 Controlling for Contamination

Since the randomization occurs at the clinician level, we are confident that the risk of contamination will be minimal[88]. However, to control for any potential contamination and assess the fidelity of delivering each intervention, we will audio-record a sample of clinical encounters. We will record consented patients. The digital recorder will be constantly present in the consulting room and a research assistant will be present to turn the recorder on when required. The research assistant will enter the room each time so the breast surgeon does not know when they are being recorded. The recording light on each recorder will be taped over so recording status can not be discerned. We will also ask all patients to indicate at T2 which intervention was used in the encounter, using images of each intervention, and will use both intention-to-treat and as-treated analyses. We will train all clinicians in delivering the intervention according to their allocated arm. Clinicians in usual care will not be trained in the use of the interventions. If there is residual contamination, the bias will be towards a null effect. We will therefore be confident that any significant findings are actual and arise as a result of the interventions. Since there are many more physicians than centers, we anticipate having greater power with physician level randomization than with site level randomization, even if the effect size we estimate is reduced by contamination.

4.1.4 Adapting the Decision Quality Instrument

In preparation for the comparative effectiveness trial, we will adapt the "What Matters Most to You" subscale of the Decision Quality Instrument (DQI)[89]. We aim to capture the factors (including potential barriers) that are important to women of lower SES when deciding about early stage breast cancer treatments and that are not currently captured in the DQI. We will conduct up to 45 semi-structured interviews with women of lower SES in both urban and rural settings.

4.2 Setting

The DQI adaptation interviews and randomized controlled trial will be conducted at four large cancer centers in the USA. The four study sites include:

- Dartmouth-Hitchcock, Lebanon, NH and Manchester, NH
- New York University (NYU) School of Medicine, New York, NY
- Montefiore Medical Center, Bronx, NY
- Joanne Knight Breast Health Center, St. Louis, MO

4.3 Participants

4.3.1 Randomized Controlled Superiority Trial (Aims 1 and 2)

We will include 600 women at least 18 years of age with a confirmed diagnosis of early stage breast cancer (I to IIIA) (see inclusion/exclusion criteria below). Approximately half will be on

Medicaid or Medicare without supplemental insurance, or uninsured (lower SES population) and about half will be women with private insurance or Medicare with supplemental insurance (higher SES population) (see 4.3.4 for stratification by SES).

Participants will be recruited across the four study sites over 18 months.

To facilitate recruitment and retention, participants will be compensated for their time with a $15 gift card at T2, T3, T4, and T5.

Participant Inclusion Criteria

The study team at each study site will use the following inclusion criteria:

- Assigned female at birth;
- At least 18 years of age;
- Confirmed diagnosis (via biopsy) of early stage breast cancer (stages I-IIIA);
- Eligible for both breast-conserving surgery and mastectomy based on medical records and clinician's opinion before surgery;
- Spoken English, Spanish, or Mandarin Chinese.

Participant Exclusion Criteria

The following exclusion criteria will be used**:**

- Transgender men and women;
- Women who have undergone prophylactic mastectomy;
- Women with visual impairment (because of the visual nature of the Picture Option Grid);
- Women with a diagnosis of severe mental illness or severe dementia;
- Women with inflammatory breast carcinoma.

Women who are receiving neoadjuvant therapy will be invited to take part in the study in the first nine months of the trial in order to be able to complete all follow-up assessments before the end of the trial. Their T3 assessment will occur after the neoadjuvant therapy has been completed and post-surgery. This may occur up to 7 months after T0 (baseline).

4.3.2 DQI Adaptation (Year 1)

We will recruit up to 45 women of lower SES who have completed treatments for early stage breast cancer in the past three years to adapt the What Matters Most subscale of the DQI. We will use purposive sampling. Participants will receive a $15 gift card.

Participant Inclusion Criteria

- Assigned female at birth;
- Between the ages of 18 and 74 years of age;
- Government insured (without supplemental insurance) or uninsured (as well as ACA marketplace plans);

- 138% of the federal poverty level or below;
- Breast cancer surgery and radiation have been completed in the past three years;
- At least spoken English.

Participant Exclusion Criteria

The following exclusion criteria will be used**:**

- Transgender men and women;
- Women who have undergone prophylactic mastectomy;
- Women >74 years of age (as other treatment options may be relevant);
- Women who are unable to complete the study procedures due to mental health impairment, cognitive impairment, or visual issues, as determined by the research staff or medical chart;
- Women with inflammatory breast carcinoma.

4.3.3 Explore Strategies that Promote the Encounter Decision Aids' Sustained Use and Dissemination (Aim 3)

We will conduct up to 100 interviews in total for Aim 3. A purposive sample of 60 participants balanced in arm, SES, and age will be invited to take part in a semi-structured interview after completion of the final follow-up assessment (T4). We will also encourage the participant's family or caregivers who are supporting the patient in making treatment decisions to attend the interview and share their perspective. Patients will be compensated with a $30 gift card. We will also include up to 10 healthcare professionals and other stakeholders per site, with and without involvement in the trial (up to 40 in total).

4.3.4 Feasibility of Recruitment

We aim to recruit 317 patients at Dartmouth-Hitchcock, Montefiore Medical Center, and Washington University in St. Louis (this number may vary depending on stratification and patient volume). Given the lower patient volume at NYU School of Medicine, we will aim to recruit 150 patients. At Dartmouth-Hitchcock, the screening exercise revealed that 339 women would have been eligible for participation in this study in 2014. This represents about 452 women potentially eligible over 18 months. At the Joanne Knight Breast Health Center (Washington University in St. Louis), 724 women would have been eligible to take part in the proposed study in 2014, representing approximately 965 eligible participants over 18 months. At Montefiore Medical Center, 443 women would have been eligible to take part in the proposed study in 2014. This represents a total of approximately 591 eligible participants over 18 months. Given a revised target sample size of 600 and varying recruitment by site, the per site enrollment will not reach these numbers, however we have accounted for this (see section 4.8 - Analysis).

Barriers to enrollment will be overcome by employing a research assistant and patient associate at each site throughout the study, by offering compensation for baseline and follow-up assessments, by informing participants of the study in advance of their surgical consultation, by developing materials with our patient and stakeholder partners using plain language and translations into Spanish and Mandarin Chinese, by offering several modes of questionnaire completion, and by working with our Community Advisory Board (see section

7.2 Conducting the Study for more detail on the Community Advisory Board) and patient and stakeholder partners to overcome potential issues with recruitment. We have allocated two extra months for the analysis and write-up of the findings, in case recruitment would need to be extended. We anticipate that the attrition rate will be minimal given the brevity of the trial, and will implement various strategies to maximize recruitment and retention.

Table 1. Recruitment Plan for the Randomized Controlled Trial

Estimated number of potentially eligible study participants	Based on administrative data: 2474
Total number of study participants expected to be screened	2400
Total number of study participants expected to be eligible	2200
Target sample size	600
Total number of practices/centers that will enroll participants	4
Projected month first participant enrolled	September 2017
Projected month last participant enrolled	February 2018
Projected rate of monthly enrollment	40

Table 2. Estimated Final Racial/Ethnic and Gender Enrollment

Race	Male (N)	Female (N)	Total (N)
American Indian/Alaska Native	**N/A (women only)**	**7**	**7**
Asian	**N/A**	**95**	**95**
Black/African American	**N/A**	**288**	**288**
Hawaiian/Pacific Islander	**N/A**	**3**	**3**
White	**N/A**	**596**	**596**
Multirace	**N/A**	**111**	**111**
Ethnicity	**Male (N)**	**Female (N)**	**Total (N)**
Hispanic (Latino/Latina)	**N/A**	**267**	**267**
Non-Hispanic	**N/A**	**833**	**833**

4.3.5 Stratification by SES

Insurance status (obtained from the patient's records) will be used to screen for higher and lower SES (lower SES: uninsured, on Medicaid or Medicare without supplemental insurance or ACA Marketplace plans; higher SES: privately insured or Medicare with supplemental insurance). At baseline, we will collect information about median household income and highest educational attainment. Considering the populations and outcomes being studied, and

no existing gold standard for the measurement of SES, using household income (commonly used in US research and census data) and highest educational attainment to measure SES (in combination with insurance status) is considered an acceptable and relevant approach and one that follows Braveman et al.'s recommendations for the measurement of SES[14,16,90]. For each included participant, we will verify whether her income is consistent with the higher or lower SES group designation made at the initial screening. As part of the analysis, we will also examine educational attainment and use a multiple-informants analysis to examine SES (see Statistical Analysis).

We will ensure that study participants are representative of the target population (i.e., women of higher and lower SES diagnosed with early stage breast cancer) by recruiting patients from four large cancer centers located in geographically diverse areas of the United States that provide a combination of urban (Joanne Knight Breast Health Center, St. Louis, MO, New York University School of Medicine, New York, NY, and Montefiore Medical Center, Bronx, NY) and rural (Dartmouth-Hitchcock, Lebanon, NH and Manchester, NH) settings as well as racially and ethnically diverse populations. The US Census Bureau rates the Bronx as the most diverse area in the US, with more than 50% of Hispanic or Latino origin[91]. Women diagnosed with early stage breast cancer at Bellevue Hospital Center (one of the hospitals associated with NYU School of Medicine) originate from approximately 80 countries, with varying race, ethnicity, and languages spoken (the majority of patients are Spanish and Mandarin Chinese speakers). In St. Louis, the proportion of African American women (approximately 23%) is higher than in the general US population. Dartmouth-Hitchcock serves a large and primarily rural population of patients in New England.

4.4 Interventions and Comparators

Encounter decision aids have been shown to increase patient knowledge, involvement in decision-making, decisional comfort, satisfaction, treatment adherence, and in some contexts, to influence choice[56-60,92]. They are showing great promise in controlled contexts and routine clinical settings[63,64,93] and demonstrate efficacy and acceptability among underserved patients[94-97]. Their comparative effectiveness across socioeconomic strata is unknown.

The interventions we have chosen are paper-based and range from one to four pages in length. The Picture Option Grid (specifically designed for women of low SES and low health literacy) has a Flesh-Kincaid grade level of 6.5. The Option Grid was written in plain language (in collaboration with the Plain English Campaign: www.plainenglish.co.uk) but was not specifically designed for women of low SES with a Flesh-Kincaid grade level of 6.6.

Both interventions are delivered and used by the surgeon during the surgical consultation. By using the same medium and delivery mode, we have facilitated a direct comparison.

Both interventions have been developed, tested, validated, and are already used in routine care (see below)[59,94,95,97-99].

4.4.1 Intervention 1: Option Grid

The **Option Grid**™ encounter decision aid for early stage breast cancer surgery is a one-page, evidence-based summary of available options presented in a tabular format (see Appendix A). The efficacy of Option Grid™ decision aids has been tested in a stepped wedge trial, where they were shown to increase patients' knowledge and SDM during the clinic visit[59]. Similar results were achieved using qualitative methods[63,65,100,101]. Option Grid decision aids are used in routine clinical practice and downloaded over 5,000 times a month (www.optiongrid.org)[61]. The Option Grid for breast cancer surgery was developed in 2010 and downloaded 1,346 times in 2016. It is evidence-based and was initially adapted from a web-based decision aid shown to facilitate readiness to decide and strengthen surgery intentions[98,99].

4.4.2 Intervention 2: Picture Option Grid

The **Picture Option Grid** was derived from the Option Grid for early stage breast cancer (see Appendix B). It uses the same evidence and integrates images and simpler text, thus exploiting pictorial superiority[73,75]. The Picture Option Grid has been specifically designed for women of lower SES and low health literacy. It was iteratively developed and tested in underserved community settings with lay women and breast cancer patients of low SES using CBPR[97]. We have tested its acceptability, feasibility, and perceived impact in 278 women of lower SES diagnosed with early stage breast cancer and with health professionals, comparing it to the Option Grid and to a comic strip pictorial encounter decision aid[94,95]. Most women of lower SES and health professionals deemed the Picture Option Grid most acceptable and usable. Several clinicians have since elected to use the Picture Option Grid in routine practice.

4.4.3 Comparator

Because decision aids are not routinely available in clinical settings, usual care is a legitimate comparator. For the purpose of this trial, usual care will include the provision of typical information resources about breast cancer that are currently available at each study site. These resources differ across study sites. To capture differences and ensure accurate portrayal of usual care at each site, we will collect detailed information about usual care at each site using methods derived from ethnography. We will also include questions about usual care at T2.

4.5 Outcomes

We have chosen outcome measures that are patient-centered and relevant to our target population with our patient and stakeholder partners. To accommodate varying levels of literacy and health literacy of our target group and to comply with patient partners' advice, we will use validated short-form questionnaires whenever possible. All patient and stakeholder partners have deemed the chosen measures important and relevant, highlighting their impact on patients' lives in both the short-term (e.g., treatment choice, anxiety) and longer-term (e.g., quality of life, decision regret). Aside from the Observer OPTION^5 scale[102], all are patient-reported outcome (PRO) measures. All included scales and tests are validated and have been developed and tested with patients. The demographic questions and item assessing the amount of out-of-pocket expenses incurred by the participant over the past month have not been validated.

We will measure outcomes at baseline (T0), during the clinic visit (T1), immediately after the visit (T2), one week post-surgery or around the first post-operative visit (T3) and 12 weeks post-surgery or around the second post-operative visit (T4). For all participants who receive surgery before May 2018, we will also measure decision regret and financial toxicity one year post-surgery (T5).

4.5.1 Primary Outcome Measure

The primary outcome measure (see Table 3) is the validated 16-item Decision Quality Instrument (DQI) for breast cancer (see Appendix C), which includes a knowledge subscale[89]. The DQI, designed to be administered post-decision, will be assessed at T2 and T3. It aims to measure the extent to which patients are informed about their options, are involved in the decision-making process, and receive a surgery (mastectomy or BCS) aligned with their values, attitude towards risks, and preferences. It produces three scores: (1) knowledge, (2) concordance, and (3) decision process. Validation demonstrated good feasibility with minimal missing data and good 4-week retest reliability for both knowledge (ICC = 0.70) and concordance (ICC > 0.72). Discriminant validity was acceptable[89].

Table 3. Outcome Measures According to Data Collection Periods

	TIMEPOINT						
	-T0	**T0 Baseline**	**T1 In-Visit**	**T2 Post-Visit**	**T3 1 wk PS***	**T4 12 wks PS****	**T5 1 yr PS**
CONSENT AND ENROLLMENT							
Eligibility Screen	X						
Informed Consent	X						
Allocation (via surgeon confirmation)	X						
INTERVENTIONS							
Arm 1: Option Grid			X				
Arm 2: Picture Option Grid			X				
Arm 3: Usual Care			X				
OUTCOME MEASURES							
Rates of recruitment – documented and tracked in REDCap		X					
Discontinuation rates – documented and tracked in REDCap		X		X	X	X	X
Demographic data – 6 items, self-reported		X					
Health literacy – 1-item Chew's health literacy screening		X					
Decision quality (primary outcome measure) – validated 16-item DQI, subscale adapted for low SES				X	X		

Knowledge – validated 5-item DQI knowledge subscale		X		(X)	(X)		
Treatment intention – self-reported via DQI				(X)			
Treatment choice – obtained from medical records					X		
Quality of life – validated 6-item EQ-5D-5L		X				X	
Anxiety – validated 8-item PROMIS anxiety short form		X		X	X	X	
Shared decision-making (observed) – validated OPTION[5]			X				
Shared decision-making (self-reported) – validated 3-item CollaboRATE				X			
Decision regret – validated 5-item decision regret scale					X	X	X
Integration of health care delivery – validated 4-item IntegRATE		X				X	
Financial toxicity – four items from validated COST measure and self-report of out-of-pocket medical expenses in the past month					X	X	X
Intervention's patterns of use – questions and photos of intervention				X	X		
System level factors + feasibility and acceptability in routine care Ethnographic methods Semi-structured interviews		X	X	X	X	X X	

PS: post-surgery
(X) included in full DQI
* or first post-operative visit
** or second post-operative visit

4.5.2 Secondary Outcome Measures

Secondary outcome measures will include treatment choice, assessed at T3 using patients' medical records, treatment intention, the validated three-item **Collabo**RATE measure of shared decision-making (SDM)[103,104], Chew's validated one-item health literacy screening question[105], PROMIS, an eight-item validated short form measure of anxiety[106], EQ-5D-5L, the validated, standardized six-item quality of life measure[107], the five-item validated decision regret scale[108], and four items from COST, a validated financial toxicity measure[109,110]. We will also ask participants to estimate the out-of-pocket (OOP) portion of their medical expenses

over the past month. We will use the recordings of clinical encounters to analyze the extent to which SDM occurs using the five-item validated observer-rated OPTION^5 scale[102]. We will also include a fidelity-of-use checklist derived from Wyatt's work to assess the actual use of encounter decision aids[56]. Finally, we will use IntegRATE, a four-item generic patient-reported measure of integration of healthcare delivery[111,112]. At T2 and T3, we will also investigate each intervention's patterns of use. At T2, the research assistant or patient associate will take a picture of each intervention post-consultation to determine how the intervention has been used and whether the patient/family and/or clinician have annotated it. At T3, participants will be asked to indicate how many times they used the intervention post-surgical consultation and whether family members, relatives, or caregivers have used the intervention.

4.6 Translation Procedure

For Spanish speakers, we will use the existing certified Spanish translations of the DQI, PROMIS anxiety short form, decision regret, EQ-5D-5L, and Chew's one item health literacy screening question and will translate CollaboRATE, IntegRATE, COST, and OOP expenses question into Spanish. For Mandarin Chinese speakers, we will use the certified translation of EQ-5D-5L, PROMIS anxiety short form, and decision regret. We will translate all other measures into simplified Mandarin Chinese in Year 1.

Our research group at the Preference Laboratory, Dartmouth College, has recently completed a review of best practices in translation of health-related materials for patients. On the basis of this review, we have developed a standard operating procedure for the translation of text into non-English languages comprising four stages:

1. Two translators who are suitably qualified and native speakers of the target language create independent translations of the original text;
2. A bilingual reviewer (who is a native speaker of the target language) compares the original text, Translation 1, and Translation 2, and either selects the preferred translation and offers revisions to the preferred translation, or produces a third translation that builds on the previous two;
3. The translation committee (i.e., two independent translators together with the bilingual reviewer) meets to review and reconcile translations by consensus;
4. The resulting translation is tested via cognitive debrief interviews with a small sample of patients fluent in the target language (see section 4.5.4).

We have successfully adopted the above procedure in the translation of patient reported outcomes measures into Latin American Spanish[113] and Polish.

We will follow the above steps for the translation of all study-related documents.
Spanish and Chinese interpreters or 'language lines' will also be available at each site before, during and after the clinic visit.

4.6.1 Cognitive Debrief Interviews for Translation of Study Documents

The study team has identified one Spanish and one Mandarin Chinese bilingual reviewer for the duties described in section 4.6. Daniela Agusti will be the Spanish bilingual reviewer.

Simon Chen will be the Mandarin Chinese bilingual reviewer. These reviewers will each conduct cognitive debrief interviews with four to five individuals to test the final translation of study documents. Participants in these interviews will be native speakers of the target language and identified through a purposive sampling strategy. Participants will be compensated the equivalent of $10 USD for their time. The bilingual reviewers will use the findings in the cognitive debrief interviews to finalize the translated study documents.

4.7 Procedure

4.7.1 Trial Setup

Between November 2016 and May 2017, the study team will seek ethical approval from Dartmouth College's Committee for the Protection of Human Subjects (CPHS) for the adaptation of the DQI and for Aims 1, 2, and 3. Dartmouth College's CPHS will be the primary ethics committee reviewing those documents on behalf of Montefiore Medical Center. NYU School of Medicine and Washington University in St Louis will seek and obtain approval from their own committee for the protection of human subjects. We anticipate that ethical approval will be granted for all study activities by August 2017.

In parallel, other study setup activities will include:

1) Recruiting a research assistant and patient associate at each site.

2) Designing all study documents in partnership with our patient partners, Community Advisory Board, and broader study team in preparation for the trial recruitment start date of September 2017.

3) Translating all study documents (outcome measures, information sheets, interventions, etc.) into Spanish and simplified Mandarin Chinese. We have allocated 10 months for the translation of these documents using the translation procedures outlined in section 4.5.3.

4) Development and launch of the study website by the end of February 2017.

5) Registration of trial on ClinicalTrials.gov.

6) Establishing the Community Advisory Board (see section 7, Engagement Plan).

7) Establishing the Data Safety and Monitoring Board.

8) Carrying-out initial study site visits (January 2017).

9) Ensuring that all relevant study team members and patient associates have undergone CITI training and made their COI declarations.

10) Training all clinicians prior to the recruitment start date. This is likely to occur in early September 2017.

4.7.2 Testing the Information Sheet, Consent Forms, and Study Questionnaires

The information sheet, trial consent document, and study questionnaires will be tested using one to two focus groups in Lebanon, NH and St. Louis, MO. Focus group participants will be recruited using a convenience sample based on availability, local contacts, and willingness to participate. Participants will be women aged 18-74, of both lower and higher SES, who have had breast cancer. They will be compensated with $15 gift cards for their participation. Food and beverages will be served at each focus group meeting.

4.7.3 Screening for Inclusion in the Randomized Controlled Trial

Insurance status (self-reported or obtained via EMR) will be used to screen for women of lower SES. For each included participant, we will check whether her income is consistent with the higher or lower SES group designation made at the initial screening or whether the patient belongs to the other group. As part of the analysis, we will also examine educational attainment and use a multiple-informants analysis to examine SES.

At each study site, our research assistants will screen for eligible participants using the inclusion criteria outlined in section 4.3.1. Eligible participants will be identified in advance of each breast clinic by the breast care team and through the outpatient appointment system and pathology reports.

At the Joanne Knight Breast Health Center and D-H patients who are eligible will receive an information sheet describing the study, sent on behalf of the breast care team at least one week before their surgical consultation. The information sheet will be short, written using plain language and pictures, and carefully developed with our patient partners, patient associates, and Community Advisory Board to address the needs of women of lower SES and low literacy/low health literacy. An introduction letter will accompany the information sheet. The letter will explain that the research team will call them a few days before their surgical consultation to discuss the study, support their decision on whether or not to take part, and help them complete the short baseline questionnaire over the phone using standardized interviews should they decide to participate.

At NYU School of Medicine and Montefiore Medical Center the research assistant will approach pre-screened patients when they come for surgical consultations and discuss the study and potential for participation while they are waiting to see the surgeon. Patients will receive the information sheet at this time. At all sites, the patients may also receive a letter signed by the surgeon that briefly introduces the study.

4.7.4 Consent and Baseline Assessment

To promote patient-centeredness and facilitate recruitment among women of lower SES, a research assistant and a patient who has had breast cancer and has completed all treatments (“patient associate”) will recruit and consent all eligible participants at each study site. Each patient associate will be recruited from breast cancer advocacy groups, existing patient networks, and contacts already established at each site. An effort will be made to recruit patient associates from lower socioeconomic backgrounds.

Consent procedures will vary slightly at each site based on the patient flow and individual needs of each clinic however at each site the research assistant will be the primary role responsible for obtaining consent. At each site, written consent will be obtained for participation in the trial.

At the Joanne Knight Breast Health Center, the patient associate and research assistant will send the information sheet and introduction letter to all potentially eligible patients and call them a few days before their scheduled appointment. They will go over the information sheet and offer to discuss the study in more detail with the patient over the phone. Each eligible patient will be told that she is potentially eligible for participation in the What Matters Most study but that eligibility will be confirmed by her surgeon during the appointment. Eligible patients will have an opportunity to ask any questions they may have and decline participation in the study at this stage. Once all questions have been answered, if patients choose to participate, they will give verbal consent to take part in the study, assuming their surgeon confirms eligibility during their upcoming clinic visit. Finally, the patient associate or research assistant will ask the patient a series of questions using standardized interviews to complete the baseline questionnaire. We have successfully used this approach with low SES groups before. An interpreter will also be involved when necessary.

At Dartmouth-Hitchcock, the patient associate and research assistant will send the information sheet and introduction letter from their surgeon and on department letterhead to all patients deemed eligible based on medical record review and surgeon confirmation. They will call each patient a few days before their scheduled appointment to go over the information sheet and offer to discuss the study in more detail with the patient over the phone. Each eligible patient will be told that she is eligible for participation in the What Matters Most study based on her surgeon's review of her medical record. Patients will have an opportunity to ask any questions they may have and decline participation in the study at this stage. Once all questions have been answered, if patients choose to participate, they will give verbal consent to take part in the study. Finally, the patient associate or research assistant will ask the patient a series of questions using standardized interviews to complete the baseline questionnaire. We have successfully used this approach with low SES groups before. An interpreter will also be involved when necessary.

At Montefiore Medical Center and NYU School of Medicine the study team will approach pre-screened and eligible patients when they come in for the surgical consultation. The research assistant and/or patient associate will introduce the study and discuss their interest in participation. Patients will receive the information sheet and may also receive a letter signed by the surgeon. If they decide to participate, provide written consent and complete the baseline questionnaire before the surgical consultation. This recruitment approach will also be followed at D-H in scenarios where the surgeon hasn't confirmed eligibility prior to the appointment with enough time given to conduct verbal consent and the baseline assessment over the phone.

At all four sites, in the event that a patient is unaware of her diagnosis prior to her surgical consultation, the surgeon will inform the patient of the study during the consultation and use the intervention (if in an intervention arm). After the appointment, the surgeon will introduce

the study and notify study staff if the patient is interested in participation at which point the research staff will obtain written consent and administer the questionnaires from T0 and T2. The study staff will approach the patient and introduce the study if the surgeon doesn't mention the study to the patient after the consultation.

Additionally, at all four sites, we will recruit participants after their surgical consultation **if they explicitly request this when first approached about the trial**. For these patients, research staff will obtain written consent and administer the questionnaires from T0 and T2 after the patient has her surgical consultation.

See Appendix D for a sample information sheet and consent form.

At all study sites, the patient associate and/or research assistant will attend the clinic whenever eligible patients are scheduled to attend a surgical consultation. They will be notified that the eligible patient has arrived by the registration staff.

At the Joanne Knight Breast Health Center, surgeons will give a card with the study name and researchers' contact details to all patients whose eligibility has been confirmed. The patient associate and/or research assistant will approach all patients who leave the consultation room with a card. The patient associate and/or research assistant will then check eligibility with the patient, obtain the signed consent, and help the patient complete the first follow-up assessment (T2).

At D-H, if verbal consent and the baseline assessment were done over the phone, the patient associate and/or research assistant will obtain the written consent (either before or after the surgical consultation), and help the patient complete the first follow-up assessment (T2). If for any reason, the patient is deemed ineligible after their consultation with the surgeon, they will be unenrolled in the study.

At NYU School of Medicine and Montefiore Medical Center, the first follow-up assessment will also be completed immediately after the surgical consultation.

At all sites, the research assistant or patient associate will read the questions to patients who cannot read or write by using standardized interviewing procedures in a private room. We will document whether the questionnaires were read to the patient using a standardized interview and whether the assistance of an interpreter was needed.

4.7.5 Randomization

Randomization will be at the clinician level, nested within study sites. We will use an R script written by the study statistician for randomization of the surgeons. The statistician will be blinded to surgeon identification. At each site, patients who have given informed consent and are seeing one of the participating clinicians will be allocated to the clinician's corresponding arm (Option Grid, Picture Option Grid, or usual care).

Approximately the same number of patients in each socioeconomic stratum will be allocated to each arm. We will monitor accrual within each arm for each socioeconomic stratum at each site to ensure that each arm has a similar number of patients in each socioeconomic stratum. The total number of patients recruited at each site will be allowed to vary.

In the intervention conditions, each participant whose eligibility has been confirmed by the surgeon during the consultation will be given a copy of the Option Grid or Picture Option Grid by their surgeon and will use it in the clinic visit.

In the usual care condition, the patients will receive care as usual and will be given a study card at the end of the consultation to signal to the research assistant or patient associate that the patient has been enrolled into the study.

4.7.6 Follow-up Assessments

During the clinic visit, we will audio-record clinical encounters with consented patients to assess the fidelity of intervention delivery (T1). After the visit, participants will be asked to complete a second questionnaire (T2). Two additional follow-up assessments will occur around 1-2 weeks (T3) and 12 weeks post- surgery (T4) (Fig. 5). For participants recruited in the first nine months of the trial, we will also conduct a follow-up assessment 1 year post-surgery (T5).

Follow up questionnaires will be administered in the clinic, when possible, and aligned with regularly scheduled return clinic visits. If this is not possible, follow-ups will be conducted either over the phone, online (sent as an email via REDCap), or on paper (sent via mail with a pre-stamped, self-addressed envelope).

To minimize respondent burden and disruption and to accommodate varying levels of literacy and health literacy, validated short-form questionnaires will be used. Each follow-up assessment (T2, T3, T4, and T5) comprises 10-34 items.

We expect that T0 (baseline assessment) will take between 15 and 30 minutes. All subsequent assessments will take approximately 10 minutes.

For each assessment, the outcome measures will be combined into one questionnaire to improve ease of use (see Table 4).

Table 4. Number of items according to data collection point

Measure	Number of Items	T0 Baseline	T2 Post-Visit	T3 1 Week Post-Surgery*	T4 12 Week Post-Surgery**	T5 1 Year Post-Surgery
Health literacy	1	X				
Demographic survey	6	X				
Decision quality	16		X	X		
Knowledge (5-item subscale of DQI)	5	X	(X)	(X)		

Treatment intention (self-reported)	1		(X)			
Quality of life	6	X			X	
Anxiety	8	X	X	X	X	
Shared decision-making (self-reported)	3		X			
Decision regret	5			X	X	X
Integration of healthcare delivery	4	X			X	
Financial toxicity	5			X	X	X
Total number of items		30	27	34	28	10

* or first post-operative visit

** or second post-operative visit

4.7.7 Monitoring Enrollment

The research assistant will closely monitor enrollment at each site on a weekly basis. The number of patients screened by the breast care team, proportion eligible (and sent an information sheet), and proportion consented and recruited in-clinic (according to SES strata) will be collected on a screening log. We plan to share information on recruitment numbers with the core team on a weekly basis and with each clinic every two weeks. Should a participant drop out, the research assistant will notify the breast care team who will review the electronic medical record to identify a potential reason for attrition. We will specifically monitor recruitment in the lower SES strata on a weekly basis. Should recruitment in this group prove slower than expected, we will solicit the advice and expertise of our patient partners, patient associates, and Community Advisory Board members to identify solutions and implement additional recruitment strategies.

4.7.8 Tracking and Retaining Participants

The research assistant or patient associate employed at each site will track participants and ensure that they are called in advance of the follow-up assessments and provided with a questionnaire in the format of their choice. Interpreter services will be used whenever necessary. Telephone calls will also be made by the patient associates whenever they are available.

Retention among patients of lower SES will be maximized by:

- Using short-form validated measures;
- Translating those measures into Spanish and simplified Mandarin Chinese;
- Using interpreter services whenever necessary;
- Calling (or emailing at Dartmouth) all participants three to five days before each follow-up assessment is due, prompting patients to complete the questionnaires and offering to conduct a standardized interview over the phone. The latter is likely to be particularly helpful in patients of lower SES and lower literacy/health literacy;
- Conducting follow-up assessments in-person when possible;
- Giving patients a choice of questionnaire format for the completion of baseline and follow-up assessments (online via email, paper-based, or standardized interviews);
- Compensating participants for their time: $15 gift card at T2, T3, T4, and T5 for patients who complete the questionnaires. Brueton et al. identified monetary incentives as an effective way of improving participant retention[114].

4.7.9 Training

All participating clinicians will receive training in using the intervention they are randomized to and in how to adhere to the trial protocol. The training will include basic communication and risk communication skills. We will use videos and role-plays. For clinicians who are not able to attend a training session in person, an online module and video will be available.

4.7.10 Adherence to Protocol and Supervision

To maximize adherence to the trial protocol, we will train all co-investigators, research assistants, and patient associates at each site in recruiting patients according to the procedures outlined in the protocol and will ensure that all principal stakeholders have received appropriate CITI training.

For the DQI adaptation interviews, the PI and research project coordinator will monitor adherence to the interview guide by reviewing the 1st and 5th interview transcript at each study site and providing feedback to the research assistants conducting interviews. We will follow the same process for the Aim 3 interviews.

In addition, the protocol will be made available to all research team members and key stakeholders in a password protected section of the website. We will provide supervision, feedback and additional training to clinicians and other study staff, as necessary at 3 months, 6 months, and 12 months into recruitment. Feedback will be provided using a preliminary analysis of the audio recordings of selected consultations across all three arms and field-notes.

4.7.11 Reporting Plan and Study Termination

Our reporting plan will diligently adhere to the updated guidelines set-out in the CONSORT 2010 statement for reporting randomized trials[87] and will be sufficiently transparent and comprehensive to allow for assessment of the study's internal and external validity.

For participants recruited in the first nine months of the study, the study will end after completing the T5 assessment (1 year post-surgery). For all other participants, the study will end 12 weeks post-surgery or after Aim 3 interviews have been conducted (where applicable). Depending on the participant, the Aim 3 interview will take place at T4 or T5. All participants will resume usual care once the study has ended.

4.8 Analysis

4.8.1 Power Calculation

For Aim 1, hypothesis 1, we base the effect size estimation on published data from randomized controlled trials of decision aids for breast cancer surgery[32,41,115,116], suggesting that a reasonable effect size for DQI is 9.34, that the standard deviation between patients in the intervention arms compared to usual care is 12.00, and that a within-physician intra-class correlation (ICC) of 0.05 is reasonable. This ICC is justified because treatment varies within clinic, thereby allowing heterogeneity that occurs between physicians across centers to be blocked. We assume that four physicians will participate in the study at each of the four clinics (at least one assigned to each of the three trial arms at each center) and assume a patient attrition rate of 20%. Under these assumptions, a study of 1,100 participants (68.75 participants per physicians and 366.66 per treatment group) has power of greater than 99.8%

to reject the null hypothesis that the encounter decision aid groups and the control group have equal means, using a two-sided 0.05 level test when the true mean difference is 9.34. Given recruitment difficulties due to seasonal trends in breast cancer diagnoses and a lower number of eligible patients than planned based on the feasibility assessments (see reasons in modification letter), the sample size has been revised to 600 participants. The power will remain above 80% for all primary hypotheses.

A crucial feature of this power calculation is that the design-effect equals 4.04, implying that approximately 4 times as many patients are needed to obtain the same power as for a study with patient-level randomization. Power remains above the traditional 80% threshold with an ICC greater than 0.19, implying that the power remains adequate even if the level of clustering of patients within physicians is greater than anticipated. Further, the attrition rate of 20% is expected to be an overestimate given the brevity of the trial. The standard deviation between patients' DQI values deliberately errs on the side of an overestimate; hence, power may be substantially greater. For hypothesis 2, we are basing the effect size estimation on the comparison between Picture Option Grid and Option Grid in women of lower SES. Because we anticipate obtaining a similar number of women in the higher and lower SES categories, the same power calculation is performed on a sample size of half the size. With 550 patients in total (34.375 patients on average per physician), under the same assumptions as above, the power for this subgroup test is 99% with ICC = 0.05 and 80% with ICC = 0.175.

For Aim 2, the power of the test for disparities between higher and lower SES is necessarily lower than the overall test at the same effect size, as four groups are compared (Picture Option Grid higher SES, Picture Option Grid lower SES, Option Grid and usual care higher SES, Option Grid and usual care lower SES). However, because patient SES varies within physician, power can be conservatively computed as if the patient-level variance was doubled and the total number of patients halved. If the true difference in the effect of the Picture Option Grid on DQI between the higher and lower SES groups is 8.5 compared to Option Grid or compared to usual care, the power for a two-sided alpha-level test at the 0.05-level is just above 80%. With a revised sample size of 600 participants, the power is unlikely to reach 80%. However, given those power calculations are resting on assumptions that may not be entirely accurate, we will know once we start the analysis if we have enough power for aim 2 hypotheses with a sample size of 600 participants. A significant finding is even more likely to be obtained if the estimated variability in the data turns out to be much smaller than assumed here. It could indeed be the case with the revised sample size. It is not critical to account for multiple testing because in both the primary (Aim 1) and secondary (Aim 2) analyses, a single pair of groups is compared.

We are assuming an effect size of 9.34 based on past studies of decision aids for breast cancer surgery[32,41,115].

4.8.2 Analysis Plan

All data will be entered into REDCap, a secure research electronic data capture database (developed for the trial), and subsequently transferred to Stata for analysis. Initial examination of data will include descriptive statistics, frequency distributions, and histograms in order to identify outliers and missing data. All participants will be asked to indicate at T2 which

intervention they have received by being shown an image of each. Using this information, we will perform both an intention-to-treat and as-treated analysis.

4.8.3 Analysis Corresponding to Aim 1

Adapting the Decision Quality Instrument in Year 01.

We will use a two-step thematic analysis derived from descriptive phenomenology, assisted by the computer software ATLAS-ti. First, the transcripts will be coded to identify DQI items and instructions that require adaptation. In a second and more detailed analysis, the interview transcripts will be coded according to all the themes discussed in the interviews, including spontaneously emerging themes. Similar codes will be merged and subsequently grouped into families of codes and networks. Dual independent coding will be used for 100% of all interview transcripts, to ensure reliability of coding and to agree the themes and family of codes for all remaining interview transcripts. Discrepancies among raters will be discussed until agreement is reached.

Aim 1: Assess the comparative effectiveness of two effective encounter decision aids (Option Grid and Picture Option Grid) against usual care, on shared decision-making, decision quality, treatment choice and other direct outcomes in women, and differentially by SES.

We will first perform separate analyses for each follow-up period using linear and logistic regression models as appropriate for continuous (decision quality, SDM, quality of life, anxiety, decision regret, and IntegRATE) and binary (treatment choice) outcomes, respectively. The results will provide potentially valuable insights into how rapidly each intervention affects outcomes. Outcomes measured multiple times after T0 (anxiety, regret, decision quality, and financial toxicity) may also be analyzed using a longitudinal model. If the interventions are found to have an effect, a secondary analysis that adds predictors for the number of prior Option Grid and Picture Option Grid patients seen by the healthcare professional will examine whether there are physician learning effects under either intervention.

We will adopt a regression framework for all analyses as it allows seamless transition between basic analyses involving a single predictor (or two indicators corresponding to each intervention versus the comparator) and more complex analyses involving additional predictors (mediation variables, control covariates, time-trends, interaction terms or effect modifiers). Further, the regression framework allows clustering of observations due to repeated measurements on patients across time, nesting of health professionals within sites, and patients within health professionals, to be accurately accounted for using mixed-effect regression models[117] or generalized estimating equations[118,119]. Multiple comparisons will be accounted for using Scheffe's method[120].

The secondary outcomes (SDM, anxiety, integration of healthcare delivery, decision regret, quality of life and financial toxicity) have in excess of 10 levels and will be analyzed as continuous variables. To assess whether the results of each analysis are trustworthy, we will analyze the residuals to check if the assumptions of the model hold[121]. For treatment choice, a clearly defined binary variable based on medical record data, we will adapt the model to a logistic regression model.

As mentioned above, insurance status will be used to screen for higher and lower SES groups and invite participants into the study. It is an accepted proxy for SES[15]. At baseline, we will also collect information about median household income and highest educational attainment. For each included participant, we will check whether income and education confirm the initial screening allocation to higher or lower SES group or whether the patient belongs to the other group. The three measures of baseline socio-economic status: (1) insurance status, (2) highest educational attainment, and (3) median household income, will be analyzed separately for a multiple informants analysis[122], or, provided they are not excessively collinear, we will enter them in the model together and test their combined effect. For income, we will use a poverty income ratio: the ratio of household income accounting for household size and poverty line published by the Census Bureau in the calendar year in which recruitment begins[123]. To aid interpretation of our results, we will report the consequence of reassigning a patient from above median SES group to below median SES group, even if for added precision, it makes sense to base significance tests on continuous measures.

To gain insight into whether the Picture Option Grid and Option Grid will be more effective in certain subpopulations, we will add each SES measure and its interaction with the intervention indicator variables to the model. If the SES intervention interaction is non-significant, we will remove them from the model and test if the overall effect of SES is significant. Otherwise, we will perform stratified analyses of the interventions' effects by SES status.

4.8.4 Analyses Corresponding to Aim 2

Aim 2: Measure the effect of the Picture Option Grid on disparities in decision-making (decision quality, knowledge and shared decision-making) and treatment choice, and conduct an exploratory analysis of the mediation and moderation effects.

A logistic regression model will be used to test for differences in decision quality, knowledge, participation in SDM, and treatment choice between the Picture Option Grid group and the usual care and Option Grid groups, within subpopulations (higher SES versus lower SES). A reduction of disparity due to the interventions will be claimed if the effect of SES on outcomes is significantly smaller for the Picture Option Grid group than for the other two groups at follow-up. As for Aim 1, a linear regression model will be used for the decision quality analysis while an analogous set of other predictors will be included as covariates in the model. The assumptions of the models will be evaluated for adequacy using residual analysis and other model fit diagnostics[121]. Our exploratory mediation analyses seek to identify and explicate the mechanism or process that underlies the relationship between the Picture Option Grid and a dependent variable via the inclusion of a third explanatory variable, known as a mediator variable (e.g., knowledge, values, SDM). We are specifically interested in whether interventions operate through the mediator as opposed to directly affecting the outcome. We will perform these analyses even if the findings from Aim 1 and Aim 2 (hypothesis 1) are non-significant in order to determine whether the null effect was due to a null effect of the intervention on the mediator or a null effect of the mediator on the outcome. To determine the generalizability of these mechanisms and identify subpopulations for whom mediation is most pronounced, we will compare the mediation effects across different subgroups (e.g., higher SES versus lower SES).

The traditional and often-used approach to estimating mediation effects is the causal steps approach, which originated in Baron and Kenny (1986)[124]. However, due to the limitations of that approach, we will estimate the mediation effect using the product of coefficients method[125]. Standard errors will be evaluated using the bootstrap[126] or the PRODCLIN program[127]. Software exists for sensitivity analysis to violations of sequential ignorability and other assumptions required for causality in mediation analyses[128,129]. We will apply this software and any additional procedures available to our analyses in order to obtain the most robust and defendable results.

4.8.5 Analyses Corresponding to Aim 3

Aim 3: Explore strategies that promote the encounter decision aids' sustained use and dissemination using a theoretical implementation model.

We will use a framework analysis, guided by Normalization Process Theory (NPT)[130,131], having successfully used this approach previously[63,101,132,133]. Observations and field-notes will be included in the analysis. Initial descriptive codes will be generated by two independent researchers based on the four NPT constructs. In-vivo coding will also be used to capture other naturally occurring exchanges. Categorical codes that group initial and in-vivo codes will be developed in a third round of coding. In addition, 100 photos of the interventions taken at T2 (approximately 50 of Option Grid and 50 of Picture Option Grid) will be included in the analysis to answer questions 1 and 2. Triangulation of data will also be performed.

NPT was developed to understand how complex interventions become implemented in routine healthcare settings[96]. NPT is built around four theoretical constructs: 1) Sense-making: processes of individual and communal sense-making of a complex intervention regarding its use and value; 2) Participation: processes of 'cognitive participation' that promote or hinder users' buy-in and commitment to the intervention; 3) Action: processes of 'collective action' that determine or hinder whether the intervention is being used by all as intended; and 4) Monitoring: Processes of communal and individual appraisal of the effect of the intervention. We will use NPT as an analytical lens to consider the data collected according to our hypotheses and the following five questions: (1) how the interventions were perceived and used in and outside the clinical encounter (including with family and caregivers), (2) preferred ways for introducing and using the intervention in routine clinical settings, from several perspectives: patients, family, health professionals, administrators (3) perceived fit in clinic workflow as well as reported barriers and facilitators to routine integration, (4) other perceived patient-, physician- and system-level barriers and facilitators to routine use, and (5) perceived generalizability and feasibility in routine care.

4.8.6 Secondary Analyses

The consultation recordings and transcriptions will be used to conduct several secondary data analyses:

Cost discussions analysis
In this analysis we will aim to (1) examine the prevalence and characteristics of cost discussions in the surgical consultations (2) investigate whether having a mention of cost in the Picture Option Grid has an effect on cost conversations, the length of the cost

conversation, and whether surgeons make referrals to outside providers or resources for patients to learn more about costs, and (3) study whether patients' financial toxicity, age, race, and/or ethnicity influence our outcomes. Our primary outcome measure will be whether or not cost was discussed in the surgical consultation. Our secondary outcome measures will include who initiated the cost conversations and the length of the conversations, if they occurred. We will also explore the number of times cost was discussed, and whether a referral had been made to address cost.

We will adapt a checklist to analyze the cost discussions from previous published literature and use it to code the recordings.[134,135] Reviewers will use a combination of audio and transcription files to code each consultation. Two reviewers will dual code a subsample of the recordings, after which kappa and percent agreement will be calculated until kappa reached .75 and percent agreement is over 90%. Once these threshholds are met, the two reviewers will independently code the remaining consultations. A third reviewer will code a 20% subsample of all consultations to ensure consistency.

We will link our analysis with patient-reported demographics (including age, race, and socioeconomic status), patient-reported financial toxicity at one week and 12 weeks post-surgery, and surgery choice as documented in the patient's electronic health record.

We will conduct linear or logistic regression analyses to examine whether our primary and secondary outcomes varied by arm (Picture Option Grid vs. Option Grid and usual care). We will explore whether financial toxicity scores, age, race, or ethnicity influenced our primary outcome. We will also conduct logistic regression analyses to evaluate whether the presence of a cost discussion influenced surgical choice.

Treatment discourse analysis

In this analysis we will aim to (1) examine whether and how breast cancer surgeons give surgical recommendations to early stage breast cancer patients eligible for both lumpectomy and mastectomy, (2) compare surgeon recommendation talk with suggested shared decision making practices, and (3) study the impact effect of clinician decision aid use (Option Grid and Picture Option Grid) on communication, conversational turn-taking, and surgical stance, and overall surgical recommendations. We will compare to usual care in the context of the decision about lumpectomy or mastectomy for early stage breast cancer.

We will analyze a sample of surgical consultations transcripts. Roughly an equal number of transcripts in each group will be coded. We will code transcripts until we reach saturation in themes (estimated at approximately thirty transcripts per arm).

The study team will devise the codebook by adapting the framework developed by Stivers' and Barnes' 2017 paper "Treatment recommendation as actions."[136] We modified their coding dimensions slightly by removing references to medications, which is not applicable in the breast cancer surgery decision, and removing the "opportunity space" code which identified turn-constructional unit boundaries by conversation analysis. We also added the following codes based on a preliminary review of transcripts: "offers comparable options," "offers time to deliberate," "patient states preferences," and "patient preferences incorporated".

We will code the transcripts using qualitative coding software (NVivo and Atlas.ti) by one researcher with a 20% subsample by a second reviewer. The study team will be available for review when questions or discrepancies arise.
Aberrant transcripts in which only one option was made available by the physician due to imaging or other medical indications (as opposed to physician preference) will be excluded. Codes will be applied according to the agreed upon code description and the context of the transcript. Coding specifics are as follows:

- We will only factors relevant to the breast cancer surgery decision. For example, we will not code detailed information on different types of radiation will, but we will code radiation as a consideration for the lumpectomy decision.
- We will not focus on the surgical logistics after a decision has been made by the patient.
- We will not code standard of care surgical treatments. For example, we will not code details about the sentinel node biopsy (performed during both mastectomy and lumpectomy) because this procedure is standard of care and does not involve comparable options.

We will code all conversations with all clinicians (including surgeons, residents, and medical students)about the early stage breast cancer surgery decision. Conversations between patients and their family members outside of the surgical consultation are occasionally recorded. Although these conversations will not be coded as they are not systematically included for all patients, interesting excerpts about the surgical decision may be marked for later consideration. After reading a transcript, coders will utilize the “memos” feature to document notes and comments on the transcripts.

We will identify major and minor themes from transcripts based on our study framework. We will select representative quotes to illustrate these themes. Additionally, a trained discourse analyst will conduct in-depth analysis of transcripts identified by coders as particularly interesting or representative.

Analysis of spoken plain language

We have three primary aims in this secondary analysis:

1. Qualitatively determine the extent to which clinicians use plain language in the context of breast cancer surgical visits,
2. Quantitatively develop a ‘listenability’ score and determine clinicians’ individual listenability scores to analyze how clinicians communicate with their patients,
3. Compare the qualitative and quantitative results across arms and according to select patient characteristics, and
4. Use existing readability software to analyze the de-identified transcripts for readability scores.

Qualitative analysis

We will use Atlas.ti to conduct a dual independent qualitative analysis of the transcripts. We will perform a deductive analysis using the US federal plain language guidelines[137-139]. We will develop a codebook from these guidelines as a team, pilot it on 2-3 transcripts, assess for

usability, make necessary changes then code all transcripts. We will also conduct inductive thematic analysis of the transcripts allowing for new codes to emerge as appropriate[138,140].

Quantitative analysis

For our quantitative analysis, we will develop a quantitative scoring method, adapted from the Listenability Style Guide and apply it to each recording[141]. We will then conduct analyses based on listenability scores and participant characteristics. Additionally, we will use readability software on each de-identified transcript to determine the "readability score" of each included transcript.

4.8.7 Missing Data

Most data collection will be via online questionnaires (i.e., at T0, T2, T3, T4, and T5), which provide opportunities for preventing and monitoring missing data. We will offer other formats for questionnaire completion (including paper and standardized interviews), thus minimizing missing data. We will prompt each patient, by telephone (or email at Dartmouth), to complete the follow-up questionnaires (i.e., T3, T4, and T5) or reach them in the clinic during their post-surgery appointments. Given the brevity of the trial and the procedures described above, we do not anticipate more than 5% of missing data. However, should there be more than a trivial amount of missing data, we will use multiple imputation to cope with missing baseline, interim, and outcome data. We will record and report all reasons for dropout and missing data. Multiple imputation creates multiple completed data sets by drawing random values of missing outcome or predictor variables from the predictive distribution of these variables given the observed variables[142]. This approach will address both generalizability and causal validity bias. We will also examine sensitivity of inferences.

4.8.8 Heterogeneity of Treatment Effects

The main goals of the heterogeneity of treatment effects (HTE) analyses are to estimate treatment effects in clinically relevant subgroups and to predict whether an individual might benefit from exposure to the decision aid. As the HTE analyses are exploratory rather than hypothesis-driven, exploratory subgroup analyses will be conducted to identify hypotheses for future evaluation. Patient characteristics will be considered for treatment by covariate interactions and include SES, age, ethnicity, race, literacy, language, and study site[143]. As described in the analytic plans for testing interactions by SES in Aims 1 and 2, interaction tests will be conducted to determine if subgroup analyses of the intervention effects by the levels of that predictor are warranted. If the interaction is significant, then the treatment effect is estimated separately at each level of the categorical variable used to define mutually exclusive subgroups.

4.8.9 Access to the Dataset

Only the statistician and core research team will have access to the final data set.
All data used in conducting the final analysis of the randomized controlled trial will be made available to PCORI in a de-identified copy for archival purposes in no more than nine months from the end of the final analysis. We will also provide a strategy for making de-identified subsets of data for collaborating researchers and organizations within nine months of completion. We also plan to develop a Data Access, Analysis, and Expression of Interest submission and review process for formal requests to make use of the data so as to prevent

duplication in analysis and publication. Given the data sharing plans, we will provide a detailed description of these plans to all participants during the informed consent process to ensure that participants are aware of all potential uses of data.

4.9 Data Management

Data management for the study will be done through REDCap, a HIPAA-compliant web-based data management system. REDCap will be hosted at Dartmouth-Hitchcock Medical Center for data collected at DHMC. Data collected from all other sites will be hosted on REDCap at Dartmouth College. REDCap is designed to support data capture for research studies, providing 1) an intuitive interface for validated data entry; 2) audit trails for tracking data manipulation and export procedures; 3) automated export procedures for seamless data downloads to common statistical packages; and 4) procedures for importing data from external sources[144]. Access will only be granted to study team members designated to manage the study data and will require a dedicated username and password. Study team members with access at participating study sites will only have access to the data at their corresponding institution This database management system is designed to comply with the ICH Good Clinical Practice (GCP) guidelines.

Data entry into REDCap will be done by research assistants and patient associates at each site using standardized data collection forms. Samples of the data collection forms will be available once they are finalized.

In addition, each study site will have a data-protected, encrypted external hard drive for the local storage of sensitive study-related materials. Each of the study sites will return the hard drives to Dartmouth College at the end of the trial. Dartmouth will store the encrypted data for six years after the conclusion of the trial, after which all data will be destroyed. No personally identifiable data will be transferred or stored outside of REDCap and encrypted hard drives.

Signed consent forms will be kept in a locked file cabinet in a secure location at each study site and kept for six years after the conclusion of the trial.

4.9.1 Data and Safety Monitoring Plan

A Data and Safety Monitoring Board (DSMB) will be appointed to provide additional oversight in the trial. The DSMB will meet and review data bi-annually throughout the project. The DSMB will include key stakeholders in the participating communities (one patient representative and breast surgeon) as well as academics with expertise in statistics, patient engagement in health care, breast cancer surgery, and health disparities. The DSMB will operate independently from the study sponsor.

The DSMB will review the protocol, data collected to date, advise the PI on any potential risks and risk mitigation plans. The DSMB recommendations will be discussed with the PI as well as the Trial Steering Group, which meets quarterly (see section 7.2). Those recommendations will also be fed back to PCORI every six months as part of the bi-annual reports. The Trial Steering Group will consider all DSMB recommendations and revise relevant aspects of the trial accordingly. All data will be reviewed for protocol adherence, including a data verification check that the appropriate outcome measures are given at the appropriate time points.

We do not expect any Serious Adverse Events (SAE) or Adverse Events (AE) in the trial that would require immediate reporting. There are no invasive procedures related to the interventions. However, some patients, particularly those with diagnosed mental illness or patients who are finding it difficult to cope with their recent cancer diagnosis, may find it stressful to be randomized to one of the two encounter decision aids or to usual care. All members of the research and medical care team who are involved in patient recruitment and follow-up assessments will be asked:

- Ahead of recruitment: To identify available counseling/psychological support. This information will be included in the cover letter and information sheet;
- During recruitment: To refer participants (who are distressed as a result of participating in the trial) to relevant counseling/psychological support services;
- During recruitment: To remind the participant that she is free to withdraw from the trial at any time without providing any reason;
- During recruitment: To notify the study PI of any participants who are withdrawing from the trial because of psychological distress or anxiety directly related to trial participation.
- During recruitment: All research assistants and patient associates will know who to refer patients to when patients have clinical questions or need additional information or support.

In addition, during each DSMB meeting, the DSMB will review data on subject withdrawals from the study and will be provided with the stated reason for withdrawal and the study subject anxiety score (measured PROMIS) for each withdrawal.

If for any reason, an SAE or AE were reported to the Principal Investigator (PI), the IRB at Dartmouth would be immediately notified as well as the appropriate safety board at the participating sites. The DSMB would convene urgently and review the SAE/AE.

5 Write-up and Dissemination

5.1 Dissemination and Implementation in Other Settings

This study is highly relevant to patient-centered care as we seek to promote the involvement of women of low SES in breast cancer treatment decisions and address disparities in this area. Currently, women of low SES are more likely to make treatment decisions based on incomplete or uninformed preferences, potentially leading to poor decision quality, poorer quality of life, and decision regret. This study hopes to identify solutions that effectively improve outcomes across socioeconomic strata and reduce disparities in quality of care (Aim 1 and 2). Addressing the current disparity in care based on SES requires effective dissemination of the results, maximizing implementation potential, and embedding these protocols into routine care (Aim 3)

It is often a challenge to bridge the gap between health research and health action and to effectively communicate results of studies to practicing clinicians, policy-makers, and patients. By dedicating a full 12 months of this project to this aim, we hope to successfully change the way shared decision-making is implemented in breast cancer treatment and provide better accessibility to women of lower SES. The study outputs will likely interest a wide variety of target audiences, ranging from patient and advocacy groups, healthcare professionals, and healthcare organizations, to academics, policy makers, and decision aid developers. This diverse group of audiences will maximize the potential for implementation and dissemination. We will work with each target audience to create dissemination and implementation strategies that are tailored to their needs and interests, understandable, and pertinent to them. Since the interventions are easily accessible and inexpensive to update and disseminate, implementation in routine care could occur immediately post-project completion. We plan to disseminate findings through the following various channels.

5.1.1 Academic Channels

Although peer-reviewed scientific journals are not commonly accessed by patients, it remains the primary source of knowledge and dissemination of research findings to influence health professionals, policy makers, and healthcare organizations. These channels will be used to ensure that clinicians have access to the study findings and are able to rapidly and successfully implement the intervention(s) in routine clinical settings. In order to promote access to patients and other non-academic stakeholders, we will publish all study outputs in open-access journals. Recently, some journals (i.e., New England Journal of Medicine) have begun including a short video abstract alongside the article. We will try to publish in academic journals with this video functionality with the aim of making the material accessible to a broader audience.

Given the vast amount of information available, many clinicians do not have time to keep up with all research literature and instead focus on clinical practice guidelines[145]. We hope that recommendations arising from this study about optimal ways to engage patients of low SES in breast cancer surgery decisions can be incorporated into clinical practice guidelines at the participating institutions and beyond.

We will also present the findings at up to four domestic and international scientific conferences (e.g., International Shared Decision Making Conference) and professional meetings to promote wider dissemination of the study findings. We hope to do a pre-conference workshop in order to train clinicians using interactive role-play and instructive videos (replicating the training of physicians in our study). It is our hope that these dissemination activities will be enhanced through networking and have a ripple effect where workshop participants will return to their own workplaces and integrate the use of successful intervention(s) into clinical practice.

5.1.2 Patient and Advocacy Organizations

We will prioritize working with national groups (e.g., Susan G Komen, Breast Cancer Alliance) and local patient advocacy groups at each participating site (e.g., Breakfast Club, Inc., Living Beyond Breast Cancer) to disseminate findings to patients, their families and caregivers, and other community stakeholders. Our research team members have established relationships with several national breast cancer and generic patient and advocacy organizations (e.g., e-

Patient Dave, Society for Participatory Medicine), which we will approach to promote the dissemination of our findings. We will compile a final report that is accessible and readable to patients and other non-academic stakeholder partners, using plain language and a lay summary. This report will serve as a summary of project findings and recommendations for implementation among organizations, health professionals, patients, and other community stakeholders. We will also create newsletters and press releases using lay language. All documents will be written in partnership with our patient partners and CAB members, and they will be freely available on the study website.

5.1.3 Professional Organizations and Healthcare Delivery Systems

Members of the research team and our panel of stakeholders are members of professional and clinical organizations, including the American Medical Association, American College of Surgeons, Society of Surgical Oncology, American Society of Breast Surgeons, American Society of Clinical Oncology, American College of Surgeons Diversity Issues Committee, International Patient Decision Aids Standards Collaboration, American College of Radiology Imaging Network, and Society for Medical Decision Making, among many others. We will disseminate our findings and successful intervention(s) to these influential professional organizations to inform practice recommendations and implement lasting changes in routine care. Further, Dartmouth-Hitchcock is part of the High Value Healthcare Collaborative, a consortium of 13 healthcare delivery systems across the United States. Communicating our findings to these healthcare systems will offer a direct opportunity for widespread dissemination, implementation, and impact.

5.1.4 Social Media and Lay Press

Increasingly, patients desire to be involved in the decisions of their care and want information that is easily accessible, relevant, and tailored to their own needs[146]. With the help of community members and patients participating in our study, we hope to create an informative, accesible video through YouTube to share the experience of study participants, the results of this study, and how they can empower patients to be more active in their healthcare choices. Additionally, we hope to provide patient-focused informational summaries and diagrams that focus on the key points and are easy to understand.

We will also use social media and partner with patient advocacy groups and patient engagement experts (e.g., e-Patient Dave, e-Patients.net, Mighty Casey) that are active on Twitter and other social media platforms to disseminate key study messages. We will work with our CAB and selected patient engagement experts (as listed above) to plan an effective social media campaign using regular Twitter feeds, blogs on the study website, and planned “tweet chats”. We will also reach the lay public who may not have access to social media by using newspaper editorials, lay press, and magazine print.

5.1.5 Dissemination Symposia and Clinician Training Module

Lastly, we will organize a symposium at each participating study site. The dissemination symposia will be guided by patients and community stakeholders to disseminate knowledge locally, facilitate knowledge transfer at each site, and foster opportunities to disseminate the research findings nationally. We will also release a brief shared decision-making training module on our website that will be based on the training delivered to clinicians in the trial and are available to health professionals to implement the interventions in routine care. We will

also disseminate this training module using the professional organizations and healthcare delivery systems mentioned in section 5.1.3.

5.2 Possible Barriers to Dissemination and Implementation

We understand that one of the greatest challenges to implementing results in clinical settings is finding sustainable partnerships, where patient-centeredness is a priority. Partnerships with patient-groups, clinicians, and patients are essential, and we have therefore made considerable efforts to achieve these goals.

We have reached out to recognized leaders in the field of patient-centered care who focus on breast cancer care (Dr. Anna Tosteson, Dr. Julie Margenthaler, Dr. Robert Volk, Dr. Karen Sepucha, Dr Dale Vidal and Dr. Sanja Percac-Lima). We have also involved several patient and stakeholder partners who will be engaged in all aspects of the project, including its dissemination and implementation. We have designed the project around a representative sample of patients, which determined our choice of four geographically diverse sites by region and population. We will ensure that the findings are effectively disseminated at each site as well as nationally using the channels listed above.

Another clear barrier to disseminating findings to patients, clinicians, and non-academic audiences is the difficulty in communicating information in a way that is clear and meaningful to each stakeholder group. We will work closely with our patient partners and clinician stakeholder partners to produce reports, newsletters, and informative videos that are understandable and pertinent.

We also recognize that barriers to sustained implementation are often due to poor clinical engagement whereby research conducted in controlled settings finds limited use in routine care. From the outset, we have been mindful to maximize the implementation and dissemination potential of the study and interventions by continuously involving clinicians and patients in every aspect of the planned trial and development of both interventions. These tools have been demonstrated to be both feasible and acceptable to clinicians in routine care with minimal impact on the consultation length[63,65,92]. Implementation will also depend on ensuring that our approach is flexible enough to be widely applicable across diverse settings and within diverse communities. This is why we will take great care to translate interventions and measures into Spanish and Mandarin Chinese and have pilot-tested them with patients from various SES, ethnic, and racial backgrounds.

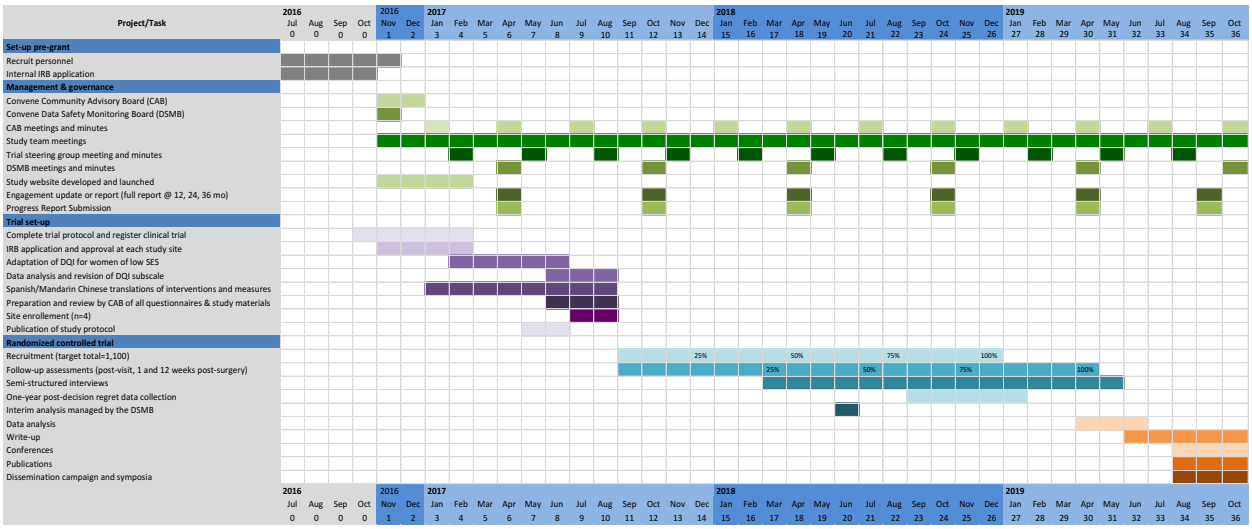
5.3 Making Results Available to Participants

As described above, we will produce a study report in collaboration with our patient and stakeholder partners and share it with all participants after study completion. The report will also be freely available to all on the study website. Further, our dissemination plan also includes organizing a local research symposium at each participating study site as a way to “meet patients and stakeholders in their own communities” and showcase findings. The PI has experience of organizing patient/stakeholder-led symposia to promote knowledge translation and disseminate research findings. These events have been shown to have a significant impact on the entire community with repercussions nationally.

6 Timeline

The study will last 36 months, starting on November 1, 2016. See Gantt Chart below for a detailed timeline.

Figure 7. Study Timeline



The following milestones will be achieved:

Table 5. Study Milestones

	Milestone Name	Description	Projected Completion Date
A	**Effective Date**	**Start of contract award**	**11/1/16**
B1	Study team meeting	First study team meeting (monthly thereafter until study completion)	11/1/16
B2	Community Advisory Board Meeting	First community advisory board (CAB) meeting, which will include patient and stakeholder partners (held quarterly until study completion) - submitt CAB meeting minutes with interim progress reports.	1/31/17
B3	Protocol Complete	Final trial protocol completed	2/28/17
B4	IRB Approval Obtained	Obtain IRB Approval(s) for study and submit approval letter(s) to PCORI.	2/28/17
B5	Select and register project at appropriate site for the study design (Clinicaltrials.gov, RoPR, or other as approved by PCORI before study start date)	Study Identification Number and the Primary Research Completion Date must be sent to PCORI.	2/28/17
B6	Study website	Study website launched	2/28/17
B7	Steering Committee Meeting	First trial Steering Committee meeting (held quarterly until study completion) - submit meeting minutes with interim progress reports.	2/28/17
B8	DSMB meeting	DSMB meeting (occurs every six months until study completion) - submit meeting minutes with interim progress reports.	4/30/17
B9	Engagement Update	For the 6-month time intervals (i.e., 6 months, 18 months, 30 months, etc. but not at 12 months or 24 months), provide specific examples of the impact of engagement on project activities during the reporting	5/1/17

		period. Report this in the Engagement Report section of the PCORI interim progress report.	
B	**Progress Report Submission**	**Submit 6-month Interim Progress Report - use PCORI interim progress report template**	**5/1/17**
C1	DQI adaptation	Decision Quality Instrument subscale "What Matters Most to You" adaptation	6/30/17
C2	Publish study protocol	Submission for publication of study protcol in peer review journal	6/30/17
C3	Outcome measures translated	Translation of study outcome measures into Spanish and Mandarin completed	8/31/17
C4	Study materials review by CAB	Preparation and review of all questionnaires and study materials by CAB and research team	8/31/17
C5	Recruitment begins	Enrollment begins for study participants (N=1,100)	9/30/17
C6	Follow-up data collection begins	Follow-up assessments begin for T2, T3, and T4	9/30/17
C7	DSMB meeting	DSMB meeting (occurs every six months until study completion) - submit meeting minutes with interim progress reports.	10/30/17
C8	Engagement Report	For each **annual** report (i.e., at year 1, year 2, etc. but not at 6 months or 18 months), additional descriptive information on engagement of patients and/or other stakeholders should be reported at https://live.datstathost.com/PCORI-Collector/Survey.ashx?Name=Engagement_Report_Login. Confirmation code should be reported in the Engagement Report section of the PCORI interim progress report.	11/1/17
C	**Progress Report Submission**	**Submit 12-month Interim Progress Report - use PCORI interim progress report template**	**11/1/17**
D1	25% recruitment	Completion of 25% of study enrollment/recruitment (275/1100)	12/31/17
D2	25% follow-up data collection	Completion of 25% of follow-up data collection	3/30/18
D3	Begin interviews	Begin semi-structured interviews (Aim 3)	3/30/18
D4	50% recruitment	Completion of 50% of study enrollment/recruitment (300/600)	5/30/18
D5	DSMB meeting	DSMB meeting (occurs every six months until study completion) - submit meeting minutes with interim progress reports.	4/30/18
D6	Engagement Update	For the 6-month time intervals (i.e., 6 months, 18 months, 30 months, etc. but not at 12 months or 24 months), provide specific examples of the impact of engagement on project activities during the reporting period. Report this in the Engagement Report section of the PCORI interim progress report.	5/1/18
D	**Progress Report Submission**	**Submit 18-month Interim Progress Report - use PCORI interim progress report template**	**5/1/18**
E1	50% follow-up data collection	Completion of 50% of follow-up data collection	7/31/18
E2	75% recruitment	Completion of 75% of study enrollment/recruitment (450/600)	9/30/18
E3	One year post decision regret data and financial toxicity data collection begins	Begin collecting decision regret measure and financial toxicity (COST) one year post-decision for all women who received surgery in the first nine months of the trial.	10/30/18
E4	DSMB meeting	DSMB meeting (occurs every six months until study completion) - submit meeting minutes with interim progress reports.	10/30/18
E5	Engagement Report	For each **annual** report (i.e., at year 1, year 2, etc. but not at 6 months or 18 months), additional descriptive information on engagement of patients and/or other stakeholders should be reported at https://live.datstathost.com/PCORI-Collector/Survey.ashx?Name=Engagement_Report_Login. Confirmation code should be reported in the Engagement Report section of the PCORI interim progress report.	11/1/18

E	**Progress Report Submission**	**Submit 24-month Interim Progress Report - use PCORI interim progress report template**	**11/1/18**
F1	75% follow-up data collection	Completion of 75% of follow-up data collection	11/30/18
F2	Completion of study enrollment	Completion of 100% of study enrollment/recruitment (600/600)	2/28/19
F3	One year post decision regret and financial toxicity data collection completed	Completion of collecting decision regret and financial toxicity measures one year post-decision for all women recruited in the first nine months of the trial.	5/31/19
F4	Completion of follow-up data collection	Completion of follow-up data collection	4/30/19
F5	Completion interviews	Completion of semi-structured interviews (Aim 3)	5/30/19
F6	DSMB meeting	DSMB meeting (occurs every six months until study completion) - submit meeting minutes with interim progress reports.	4/30/19
F7	Engagement Update	For the 6-month time intervals (i.e., 6 months, 18 months, 30 months, etc. but not at 12 months or 24 months), provide specific examples of the impact of engagement on project activities during the reporting period. Report this in the Engagement Report section of the PCORI interim progress report.	5/1/19
F	**Progress Report Submission**	**Submit 30-month Interim Progress Report - use PCORI interim progress report template**	**5/1/19**
G1	Final analyses	Final analyses completed	8/31/19
G2	Dissemination of findings	Dissemination of research findings	10/30/19
G3	Dissemination symposium	Dissemination symposium at each participating study site	10/30/19
G4	DSMB meeting	DSMB meeting (occurs every six months until study completion) - submit meeting minutes with interim progress reports.	10/30/19
G5	Engagement Report	For each **annual** report (i.e., at year 1, year 2, etc. but not at 6 months or 18 months), additional descriptive information on engagement of patients and/or other stakeholders should be reported at https://live.datstathost.com/PCORI-Collector/Survey.ashx?Name=Engagement_Report_Login. Confirmation code should be reported in the Engagement Report section of the PCORI interim progress report.	11/1/19
G	**Final Progress Report Submission**	**Submit Final Progress Report - use PCOR final progress report template**	**11/1/19**
H	**Research Project Period End Date**		**11/1/19**
I	Primary Research Completion Date	A Primary Research Completion Date must be provided when registering the study in Clinicaltrials.gov. For studies that are not clinical trials or observational studies registered on ClinicalTrials.gov, the Awardee and PCORI shall agree on a primary completion date as a milestone that precedes the agreed-upon date to submit a Draft Final Research Report.	4/30/19
J	Results submitted to ClinicalTrials.gov or appropriate database.	Awardee ensures results are submitted to ClinicalTrials.gov or appropriate database. For ClinicalTrials.gov, the generated tables are a required section in the Draft Final Research Report.	4/30/20
K	**Draft Final Research Report Submission**	**Submit Draft Final Research Report according to instructions found at** *http://www.pcori.org/awardee-resources* ***Draft Final Research Report must be submitted no later than 30 days from when results are posted to clinicaltrials.gov or other applicable website.***	**5/30/20**
L	**Final Research Report**	**Upon receipt of written summary, and as applicable, PI will make revisions and submit revised Draft Final Research Report for acceptance as directed by PCORI.**	**11/30/20**
M	**Approval / sign off of the Lay Abstract**	**Sign off must be no later than 90 days beyond the date PCORI accepts the final report**	**11/30/20**
N	**Contract Term Date**	**-**	**11/30/20**

O	**Final Expenditure Report**	**Submit Final Expenditure Report (See Contract for Instructions)**	**2/28/21**
P	**Notification of Publication Acceptance**	**See Contract for Instructions**	**Within 30 Days of Acceptance**

7 Engagement Plan

7.1 Planning the Study

The involvement of patient and stakeholder partners has been instrumental in designing and planning the study. The topic was originally identified from conducting a systematic review and a broader gap analysis of the literature focusing on patient and clinician perspectives. Our findings and preliminary research questions were discussed with our initial patient partner, Linda Walling, and subsequently introduced to nine other patient and stakeholder partners in a focus group and research meetings. The literature search identified important gaps in efforts to increase decision quality and mitigate disparities in early stage breast cancer care. Our patient and stakeholder partners immediately echoed those findings and insisted on the short-term (e.g., increased anxiety) and long-term implications (such as poor quality of life) of playing a passive role in healthcare decisions and failing to make an informed choice about breast cancer treatments.

From the start, we have engaged patient partners from different locations (New Hampshire, California, and Missouri) and backgrounds. We have also engaged the broader stakeholder community in developing the research questions and testing and validating the Picture Option Grid, adapted from the validated Option Grid for women of low SES. Our stakeholder partners included breast surgeons, a parish nurse, two social workers, the executive director of the Upper Valley Haven (a nonprofit organization that provides temporary shelter and educational programming for homeless families and adults), and a breast cancer patient advocate who facilitates the “Living Beyond Breast Cancer” telephone group (three of which have been named on in this protocol). All patient and stakeholder partners have been actively involved in regular research meetings and have attended a focus group where the research questions, study outcomes, study design, and characteristics of the study participants were discussed. Their input has significantly shaped and influenced the study design. For instance, they have identified ways to minimize disruption to study participants by suggesting the involvement of a patient associate and by using short-form validated measures whenever possible. To promote retention among women with varying literacy and health literacy levels, our patient partners suggested calling or emailing participants before each follow-up assessment was due and offering to complete the questionnaire on the phone using standardized interviews.

Our patient and stakeholder partners were also involved in identifying the goals and outcomes of the interventions. Our patient partners emphasized the surge of fear and anxiety associated with their breast cancer diagnosis and subsequent treatment decisions. They also underscored the impact of the diagnosis and treatment on their quality of life. One of our patient partners recalled having trouble sleeping and worrying about the implications of her disease and treatment choice and described the impact on her quality of life. Our patient partners felt that it was essential to measure anxiety and quality of life. These measures were thus chosen and reviewed with them.

Finally, our patient and stakeholder partners were involved in writing and reviewing the Research Plan and Abstract. They helped us simplify language for the public abstract and ensure that their views were accurately represented.

7.2 Conducting the Study

To facilitate recruitment, and taking into account the fact that a diagnosis of early stage breast cancer is emotionally sensitive and anxiety provoking, the research team (in consultation with patient partners) has deliberately chosen to include one patient associate at each site. The patient associate is a former breast cancer patient who will be recruited at each study site from local breast cancer patient groups or advocacy programs. She will partner with each research assistant by approaching, informing, and gaining patients' informed consents in clinics. She will receive appropriate research and CITI training. She will also collect baseline and follow-up data with the research assistant and conduct some Aim 3 interviews in the second and third year of the project. Lastly, the patient associate will be involved in analyzing the data. One of our patient partners strongly advocated for including a patient associate because, in her words, a former patient "has already been through similar experiences" and will approach patients from a more empathic perspective.

We recognize that patient groups at each site will vary. To meet site-specific needs and be consistent with the CBPR approach, we will include Community Advisory Board (CAB) members from each study site, who will monitor and report back to the steering group. The CAB will include multiple stakeholders whose role is to meet quarterly, examine trial progress, and report findings to the steering committee. The patient associates will also be invited to join all CAB meetings. One member of the CAB (as well as all patient partners named as key personnel) will be invited to attend all Trial Steering Group meetings and relay the CAB's discussion and action points:

- A Trial Steering Group that will involve all key personnel (including patient and stakeholder partners and invited CAB members) will meet every three months using videoconferencing;
- Research Team meetings will be held on a monthly basis and will include key personnel from each study site including patient and stakeholder partners.

In addition, all study documents including information sheets, consent forms, questionnaires, and interview schedules will be developed with patient partners, patient associates, and the CAB.

7.3 Understanding Patient Engagement in What Matters Most

In order to learn more about patient engagement in the What Matters Most study, we will conduct interviews with our patient and community stakeholders.

An external researcher will interview the patient associates midway through and after recruitment is complete. The interview guide will assess the patient associate's feelings about research and their involvement with the research team, recruiting patients, challenges they face, and their thoughts about the involvement of patient associates in future research. Patient associates also sent reflections and notes intermittently to the study team. An external researcher will also interview WMM patient partners about their participation in the study. The interview guide will ask about the patient partner's engagement with the research team and their experiences on with the various groups involved in the study (e.g., monthly

study meeting, quarterly trial steering group meeting). A research team member will interview patients that sit on the CAB to learn more about the distinguishing features of the CAB and the patients' experience on this board.

These interviews are expected to last about 30 minutes each. An information sheet detailing the purpose and confidentiality of the interview will be provided to each participant. The interviews will be recorded, provided the interviewee provides consent to recording. Recordings will be securely maintained and transcribed verbatim.

We will also reach out to the research assistants to ask them about their experience working with patient associates during the study. We will send them an anonymous survey link which includes questions around their role in the study and what it was like to work with the patient associate at their site.

7.4 Principles for Engagement

7.4.1 Reciprocal Relationships

As part of the initial planning process, we asked all research partners, including patient partners and stakeholders, to contribute their opinions and expertise to the development and design of the project. We will take this approach forward into the funded project and are committed to fostering reciprocal relationships among all members of the research team, the CAB, and steering committee throughout the trial set-up, data collection and data analysis phases. Consistent with the CBPR approach, this implies that all partners are equally accountable for decisions, project changes, and study processes. Consequently, we have assigned all patient and stakeholder partners as "key personnel," recognizing each contributor's critical role and responsibilities.

7.4.2 Co-Learning

Our research team has a long history of developing decision aids that are both patient-centered and patient-led and that follow user-centered design principles[105]. Consequently, we view patients and stakeholders as teachers as well as partners. They are experts on their lived experiences, attitudes toward risks and benefits, and informed values and preferences. We ensure that others learn from their expertise by including patients and stakeholders as authors on manuscripts and, where possible, have them contribute to academic and non-academic presentations. We will ensure that this level of involvement continues during this project by adopting plain-language standards and asking our patient and stakeholder partners to review and contribute to all study outputs. No distinction has been, or will be, made between the roles of patients, stakeholders, clinicians, or researchers during any decision-making process. Our patient associates will also take part in all aspects of data collection and data analysis, where possible.

7.4.3 Partnership

From the outset, we have valued the contributions of our patient and stakeholder partners by applying suggested modifications to the study design, research questions, and intervention design. For example, we have changed the title of the interventions to 'What's right for me?', which was deemed more explicit and accessible than 'Picture Option Grid'. We are committed to this process and have made every effort to include regular CAB and steering committee sessions to capture patient and stakeholder opinions, thus ensuring a consistent feedback

loop to keep project goals consistent with patient-centered principles. We will be compensating patient and stakeholder partners at a rate that has been agreed with them ($100 per hour) and that reflects their commitment and expertise.

7.4.4 Trust, Transparency, Honesty

A foundation of our work is based on principles of trust and transparency—the building blocks of strong relationships. These underpin our research team's approach by ensuring all members of the research team, including patient and stakeholder partners, are constantly updated by email or conference call to monitor the study's progress, solve potential issues, and discuss any alterations to the research plan and trial protocol. Ultimately, we recognize that trust is built over time through transparency and honest approaches to communication, data collection, analysis, and reporting. To keep true to our word, we will share materials at all stages of the study process, provide access to our project website, and actively seek the opinions and feedback of patient and stakeholder partners as well as the CAB. All major decisions will be made collaboratively and discussed at scheduled meetings with the research team (including patient and stakeholder partners) or via email correspondence for any urgent matters.

8 Ethical Considerations

Human subjects will be involved in this research in:

- The adaptation of the DQI subscale for women of lower SES in year 1;
- Cognitive debrief interviews to test translation of study documents;
- Focus groups to test the information sheet and informed consent form;
- The randomized controlled trial in years 1, 2, and 3 (Aims 1 and 2);
- Interviews, field-notes, and observations to explore strategies that promote the interventions' sustained use (Aim 3).

In designing this study, we have taken steps to minimize the probability and magnitude of all or any physical or psychological harm to human subjects. We have also ensured that any potential risks are offset by potential benefits to study participants and to the population of women who will receive a diagnosis of breast cancer in the future. All participants will be able to provide voluntary informed consent prior to data collection. All data collected will be stored securely with restricted access, thereby minimizing risks to the privacy of all human subjects involved in the study. Institutional Review Board (IRB) approval will be obtained from the Dartmouth College Committee for the Protection of Human Subjects (CPHS) prior to the involvement of human subjects in the research. We will adhere strictly to all protocols and ensure that all potential risks to human subjects are reviewed by the DSMB every six months (see section 6 Timeline).

8.1 Adapting the Decision Quality Instrument (DQI) Subscale (Year 1)

8.1.1 Risk to Human Subjects

Human Subjects Involvement, Characteristics, and Design

In preparation for the comparative effectiveness trial, we will adapt the "What Matters Most to You" subscale of the Decision Quality Instrument. We will conduct up to 45 semi-structured interviews with women of lower SES at all four cancer centers involved in the trial. As mentioned in the Research Strategy section, we will include women over 18 years of age of lower SES who are uninsured or on Medicaid or Medicare without supplemental insurance (or ACA marketplace plans) who have completed treatments in the past three years. We will exclude women over 75 years of age and those with visual impairment, a diagnosis of psychosis or severe dementia, or inflammatory breast carcinoma.

Sources of Materials

In conducting the semi-structured interviews, we will collect information on participant characteristics (i.e., age, race, ethnicity, median household income, insurance status, highest educational attainment, and health literacy). The interviews will seek to understand which factors affect women's treatment decisions related to breast cancer in women of lower SES. We will remove any identifying information from the audio-recording transcripts. We will not require participants to provide written consent to take part in the interviews but will audio-record participants' verbal consent at the interview's outset. At the Joanne Knight Breast Health Center, written informed consent will be obtained. Each audio recording will be labeled with a unique, anonymous study identification (SI) number. A record of the names, contact

details of the participants, and their unique SI numbers will be stored securely in the REDCap database and separately from the audio recordings.

Potential Risks

We do not anticipate any physical, financial, legal, or other risks to the interview participants beyond those of natural occurrence. We anticipate potential risks to be limited to psychological discomfort. If this were to occur, we will immediately terminate the interview and ensure that appropriate support (such as access to a psychologist or social worker) is provided. Interviews will be conducted in private.

8.1.2 Adequacy of Protection Against Risks

Recruitment and Informed Consent

Eligible participants will be identified by co-investigators and stakeholder partners at each participating site and through existing patient support and advocacy groups. Participants' names and contact details will be transferred to the research team using the REDCap database. No personally identifiable information will be transferred or stored outside the REDCap and encrypted hard drives. Eligible participants will be sent an information sheet by mail describing the study aims and methodology. Subsequently, potential participants will be contacted by phone or in person and given an opportunity to ask questions before deciding whether or not to take part in the study. To facilitate recruitment, we will offer $30 gift cards for participation in the semi-structured interviews. We will interview participants in person, by phone, or at their home, whichever is more convenient for them.

Protections Against Risk

We anticipate minimal potential risks. Information on eligible participants solicited from the study sites and shared with researchers from Dartmouth College and subcontracting institutions will be stored safely in the REDCap database. The names and contact details of participants who decline to take part in the study will be immediately deleted from the database.

As part of the standard consent process, participants will be advised that they are free to withdraw from the study at any time without providing any reason and without any impact on them or on the medical care they receive. Participant compensation of $15 has been carefully chosen and discussed with our patient and stakeholder partners so as not to exert undue influence on participation.

All data will be stored in encrypted external hard drives and in the REDCap database. Anonymized data will be retained for six years after the conclusion of the study, per Dartmouth's CPHS requirements, and then destroyed. Although potential risks to patients are minimal, the Data Safety Monitoring Board will review the interview data at their October 2017 meeting. We do not foresee any risks or adverse events.

Interview recordings will be transcribed using a HIPAA-compliant company. Recording files and subsequent transcripts will be transferred using a secure FTP.

8.2 Years 1, 2, and 3: Randomized Controlled Trial (Aims 1 and 2)

8.2.1 Risk to Human Subjects

Human Subjects Involvement, Characteristics, and Design

We plan to recruit 600 women (approximately 300 higher SES and approximately 300 lower SES). Participants eligible for the trial will be women (a) with a confirmed diagnosis of early stage breast cancer (I to IIIA); (b) eligible for both BCS and mastectomy; (c) at least 18 years old; and (d) with at least a basic comprehension (6th grade level) of English, Spanish or Mandarin Chinese (e) assigned female sex at birth. We will exclude:

- Transgender men and women;
- Women who have undergone prophylactic mastectomy;
- Women with diagnosis of psychosis or severe dementia;
- Women with inflammatory breast carcinoma.

Sources of Materials

Using five questionnaires (at T0, T2, T3, T4, and T5), we will collect information on primary and secondary outcome measures. The questionnaires will also assess patient characteristics (e.g., age, race, ethnicity, median household income, insurance status, highest educational attainment, and health literacy). All information will be stored securely on the REDCap database and in encrypted external drives.

Potential Risks

We do not anticipate any physical, financial, legal, or other risks to the participants beyond those of natural occurrence. We anticipate potential risks to be limited to psychological discomfort. If this were to occur, we would ensure that appropriate support (such as access to a psychologist or social worker) is made available at each participating site.

8.2.2 Adequacy of Protection Against Risks

Recruitment and Informed Consent

Eligible participants will be identified in advance by the breast-care team at each study site and through the outpatient appointment system and pathology reports. Eligible participants at Washington University in St. Louis will receive an information sheet and an introduction letter in the mail in advance of their surgical consultation. The information sheet will be short, written using plain language, and include pictures to describe the study.

The letter will explain that a patient associate (i.e., a former breast cancer patient) or research assistant will call during the week before the consultation to answer any questions about the study, discuss the consent process, and help complete baseline questionnaire should they wish to participate. Each eligible patient will be told (in letter and on the phone/face-to-face) that she is potentially eligible to participate in the study but that eligibility will be confirmed by her sureon during her surgical consultation. Once all questions have been answered, patients will give verbal consent to take part in the study and, if her surgon confirms her eligibility, a written consent following the consultation.

At other sites, the patient associate or research assistant will be in the clinic to meet the patients before the surgical consultation. Together with the patient associate and research assistant, the patients will have an opportunity to (a) review the information sheet if they have not yet had a chance to do so; (b) ask any questions they may have about the study; (c) give

consent, should they wish to take part; and (d) complete the baseline questionnaire before seeing their surgeon.
Participants will be subsequently allocated to receiving Option Grid, Picture Option Grid, or usual care depending on the surgeon they are scheduled to see that day. The purpose of involving a patient associate is to promote patient-centeredness and facilitate recruitment in a context that is highly sensitive and emotional for potential participants given their recent cancer diagnosis. All signed consent forms will be stored securely in locked cabinets at each study site and collected by the PI at regular intervals.

Protections Against Risks

We anticipate minimal potential risks. First, privacy of individuals and confidentiality of data will be protected using the following procedures. Information on eligible participants collected at each study sites prior to consent and in the questionnaires after consent will only be shared with IRB-trained researchers from Dartmouth College and subcontracting institutions. It will be stored securely on the REDCap database. Names and contact details of participants who decline to take part in the study will be immediately deleted from the database.

Patients who have consented to take part in the study will be assigned a unique, anonymous study identification number. All identifying patient information will be deleted prior to analysis. Any printed forms with patient data (including the consent forms) will be stored in a locked cabinet or shredded. All digital data will be stored in encrypted external hard drives and in the REDCap database. Anonymized data will be retained for six years after the conclusion of the study, per Dartmouth's CPHS requirements, and then destroyed. Paper-based signed consent forms will be shredded six years post study completion date.

As part of the standard consent process, participants will be advised that they are free to withdraw from the study at any time, without providing any reason or any impact on them or on the care they receive. Participant compensation of $15 for the baseline and post-visit assessment in clinic, as well as subsequent $15 gift cards for each follow-up questionnaire, has been carefully chosen and discussed with our patient and stakeholder partners so as not to exert undue influence on patient consent.

8.3 Interviews, field-notes and observations to explore strategies that promote the interventions' sustained use (Aim 3)

8.3.1 Risk to Human Subjects

Human Subjects Involvement, Characteristics, and Design

In order to facilitate implementation in routine clinical settings, we will assess the perceived acceptability and feasibility of the Picture Option Grid and Option Grid in routine clinical settings. We will also assess perceived patient-, physician-, and system-level barriers and facilitators to routine use and explore strategies for promoting the interventions' sustained use. At each site, we will select a purposive sample of up to 15 trial participants of varying SES, age, race, ethnicity, and language spoken in both intervention arms. These identified participants will be invited to take part in a semi-structured interview after they have completed the final follow-up assessment (T4). We will also encourage a family member, caregiver, or close relative to attend the interview and share their views. Patients will be compensated with

a $30 gift card. Additionally, we will conduct interviews with up to 10 clinicians, social workers, administrators, and other stakeholders at each site, with and without involvement in the trial. Healthcare professionals and other stakeholders will not be compensated for their participation. We will conduct up to 100 interviews in total at T4.

Sources of Materials

As part of the semi-structured interviews, we will collect no new personal information from patients other than what has already been collected in the trial. We will collect information about occupation, time in current position, age, gender, race, and ethnicity from all participating healthcare professionals and other stakeholders at each study site. All personal participant information will be stored securely in the REDCap database. No personally identifiable information will be transferred or stored outside REDCAp and encrypted hard drives.

Potential Risks

We do not anticipate any physical, financial, legal, or other risks to the participants beyond those of a natural occurrence. Interviews will be conducted in private, and no identifying information or information on a participant's health status will be actively sought. We anticipate potential risks to be limited to psychological discomfort. If this were to occur, we would ensure that appropriate support (such as access to a psychologist or social worker) is made available at each participating site.

8.3.2 Adequacy of Protection Against Risks

Recruitment and Informed Consent

In Years 2 and 3, and after the patient's T4 follow-up assessment has been completed, we will recruit a convenience sample of participants who have taken part in the randomized controlled trial to ensure involvement of patients of varying SES, trial arms, age, race, ethnicity, and language spoken. We will contact each participant by phone to ask whether they consent to take part in a telephone semi-structured interview. Verbal consent will be audio-recorded on the telephone at the interview onset.

Once the last patient has been recruited for these T4 interviews, we will recruit a small sample of up to 10 healthcare professionals and other stakeholders at each study site. We will email each of them and invite them to participate in a telephone or in-person semi-structured interview. Verbal consent will be audio-recorded on the telephone before the interview begins.

8.3.3 Protections Against Risk

We anticipate minimal potential risks. As part of the standard consent process, participants will be advised that they are free to withdraw from the study at any time. Participant compensation of $30 has been carefully chosen and discussed with our patient and stakeholder partners so as not to exert undue influence on participation. Healthcare professionals and other stakeholders will not be compensated for their participation.

All data will be stored in encrypted external hard drives and in the REDCap database. Anonymized data will be retained for six years after the conclusion of the study, per Dartmouth's CPHS requirements, and then destroyed.

8.4 Education of Key Personnel on the Protection of Human Subject Participants

Before data collection starts, all key study personnel (i.e., all study personnel except the scientific consultants) will be required to undertake appropriate Collaborative Institutional Training Initiative (CITI), including, but not limited to, Health Insurance Portability and Accountability Act (HIPAA) training.

8.5 Potential Benefits of the Proposed Research to Human Subjects and Others

Women who participate in this study and are allocated to the intervention arms will benefit from one of two interventions, which have been shown to increase knowledge and shared decision-making in the clinical encounter, at the minimum. All participants will have an opportunity to provide feedback on the communication patterns they have experienced with their doctor and care team and on the extent to which shared decision-making was fostered. Women who take part in the Aim 3 interviews will also get a chance to provide feedback on the optimal use of an encounter decision aid in routine clinical settings. Lastly, the knowledge gained from this project will determine the strategy that is most effective in promoting high-quality breast cancer treatment choices in women of low SES and in potentially reducing healthcare disparities.

8.6 Importance of the Knowledge to Be Gained

The knowledge to be gained in this study is critical to understanding how best to empower women of low SES in making high-quality, informed decisions about breast cancer treatment. The interventions evaluated in this comparative effectiveness trial are likely to improve decision quality and the alignment between treatment chosen, knowledge about key differences, harms and benefits of those options, women's values and preferences, and quality of life, while reducing anxiety and decision regret. We also anticipate that disparities between women of higher and lower SES will be reduced.

8.7 Inclusion of Women and Minorities

8.7.1 Planned Distribution of Subjects

For all aims and activities, we will be recruiting women (assigned female at birth) only. Given that the study is focused on early stage breast cancer in women and that the intervention is targeted at women, men will be excluded from the study. Transgender men will also be excluded as their treatment course would be managed on a case-by-case basis.

8.7.2 Subject Selection Criteria

We have selected women of different ethnicity and race to represent the diversity of women of higher and lower SES who will be diagnosed with early stage breast cancer (I to IIIA) at all four participating study sites. We will ensure that study participants are representative of the target population (i.e., women of higher and lower SES diagnosed with early stage breast cancer) by recruiting patients from four large cancer centers located in geographically diverse areas that provide a combination of urban (Joanne Knight Breast Health Center, St. Louis, MO; Montefiore Medical Center, Bronx, NY; NYU School of Medicine, New York, NY) and rural settings (Dartmouth-Hitchcock, Lebanon, NH and Manchester, NH) as well as racially and ethnically diverse populations.

Men are excluded from this study because:

- Early stage breast cancer is about 100 times less common in men than in women;
- There are fewer options for men given the relative paucity of breast tissue. These shared decision-making resources do not, therefore, apply to this small sub-set of patients;
- The intervention was specifically targeted at women diagnosed with early stage breast cancer (e.g., images of female anatomy only).

8.7.3 Outreach Programs

In order to recruit patients of different race, ethnicity, and languages spoken, we will work with the Community Advisory Board, patient advisors, and patient associates. We will also work closely with research assistants, patient associates, and research coordinators at each clinic to ensure that patients with varying levels of literacy are adequately supported to use the interventions and complete the questionnaires. We will also involve interpreters at each site as and when necessary. All study materials including the interventions will be translated into Spanish and Mandarin Chinese.

8.8 Inclusion of Children

8.8.1 Justification for the Exclusion of Children

Children are excluded from the proposed study because:

- Breast cancer is not diagnosed in patients under the age of 18. Most breast tumors in children are fibroadenomas and are thus benign. The interventions that we have developed are not applicable to children with benign clinical diagnoses;
- The interventions being studied were developed and tested with adults at least 18 years of age and include images and text that are tailored to older adults. This resource is not designed to be usable and acceptable in this young population.

9 Study Management and Finance

Dr. Durand, as contact PI, will be responsible for day-to-day logistical management, and will have financial responsibility for the trial. She will be supported and mentored by Professor Glyn Elwyn, Co-PI, who holds a tenured chair at Dartmouth College. He is also Co-PI on a trial of encounter decision aids for family planning funded by PCORI, and initiator of the Option Grid Collaborative. Their complementary expertise and longstanding collaboration will be pivotal in successfully leading and managing this project.

9.1 Trial Steering Group and Research Team

A Trial Steering Group will involve all key personnel (including patient and stakeholder partners and invited CAB members) and will meet every three months using videoconferencing. Research team meetings will also be held on a monthly basis and will include key personnel from each study site, including patient and stakeholder partners. The duties of the TSG will include supervising the trial, monitoring trial progress, as well as reviewing and acting on all DSMB recommendations. Dartmouth College will have responsibility for centralized study management and general oversight. The research team at Dartmouth will maintain all aspects of the trial and work closely with each study site to coordinate all trial activities.

9.2 Community Advisory Board

We recognize that patient groups at each site will vary. To meet site-specific needs, and consistent with the CBPR approach, we will include Community Advisory Board (CAB) members from each study site, who will monitor and report back to the steering group. The CAB will include multiple stakeholders whose role is to meet quarterly and examine trial progress and report findings to the steering committee. The patient associates will also be invited to join each CAB meetings. One member of the CAB (as well as all patient partners named as key personnel) will be invited to attend all Trial Steering Group meetings and relay the CAB's discussion and action points. See Appendix E-1 for the CAB Terms of Reference.

9.3 Data Safety Monitoring Board

A Data and Safety Monitoring Board (DSMB) will be appointed to provide additional oversight in the trial (see section 4.9.1 for additional information). DSMB membership will comprise of seven members including experts in or representatives of the fields of shared decision making, breast cancer surgery, patient advocacy, statistics, and clinical trials methodology. The DSMB will operate independently from the study sponsor. See Appendix E-2 for the DSMB Terms of Reference and Appendix F for the DSMB charter.

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11 APPENDIX A. OPTION GRID

Breast cancer: surgical options

Use this **Option Grid™** decision aid to help you and your healthcare professional talk about how to best treat your breast cancer. This decision aid is for women with early stage breast cancer (stages I to IIIA).

Frequently asked questions	Lumpectomy with radiation	Mastectomy
What is removed?	The cancer lump is removed, with some surrounding tissue.	The whole breast is removed.
Which surgery is best for long-term survival?	Long-term survival rates are the same for both surgeries.	Long-term survival rates are the same for both surgeries.
What are the chances of cancer coming back in the breast?	Breast cancer will come back in the breast in about 5 to 10 in 100 women (5-10%) in the 10 years after a lumpectomy.	Breast cancer will come back in the area of the scar in about 5 to 10 in 100 women (5-10%) in the 10 years after a mastectomy.
Will I need more than one surgery?	Possibly, 20 in 100 women (20%) may need another surgery to remove breast tissue or lymph node that have cancer.	Possibly, if your lymph nodes have cancer. Yes, if you choose breast reconstruction.
How long will it take to recover?	Most women are home within 24 hours of surgery.	Most women are home within 24 hours of surgery. It may take longer with reconstruction.
Will I need radiation after surgery?	Yes, for up to seven weeks after surgery.	Radiation is not usually given after mastectomy.
Will my lymph nodes be removed?	If cancer has spread to the lymph nodes under your arm, your doctor will discuss with you whether you need more treatment such as surgery or radiotherapy.	If cancer has spread to the lymph nodes under your arm, your doctor will discuss with you whether you need more treatment such as surgery or radiotherapy.
Will I need chemotherapy?	You may be offered chemotherapy, but this does not depend on the surgery you choose.	You may be offered chemotherapy, but this does not depend on the surgery you choose.
Will I lose my hair?	Hair loss is common after chemotherapy.	Hair loss is common after chemotherapy.

Editors: Marie-Anne Durand (Lead Editor), Glyn Elwyn, Lisa Caldon, Kari Rosenkranz, Dale Collins Vidal, Stephanie Sivell, Malcolm Reed
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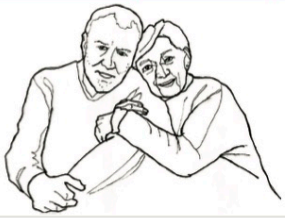
12 APPENDIX B. PICTURE OPTION GRID

Early stage breast cancer: What's right for me?

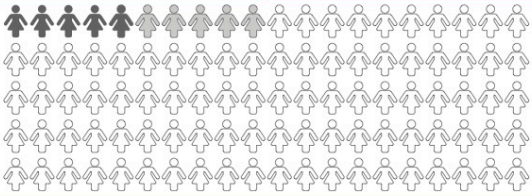
picture option grid

Use this **Picture Option Grid** to help you and your healthcare professional decide how best to treat early stage breast cancer (stages I to IIIA). The last page is for **your notes, thoughts, or any questions** for you to discuss with your doctor.

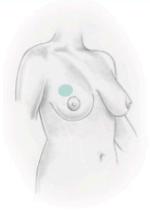
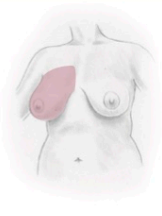
1. Will it affect how long I live?

Lumpectomy with radiation	Mastectomy
	
No, how long you live is the same for both surgeries.	

2. Will cancer come back in the breast?

Lumpectomy with radiation	Mastectomy
	
Within 10 years, breast cancer returns for about **5-10 in 100 women (5-10%)**. This depends on the cancer stage and tumor characteristics, rather than on the type of surgery. Please discuss your individual risks with your doctor.	

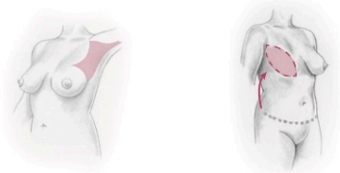
3. What is removed in the breast?

Lumpectomy with radiation	Mastectomy
	
Only the cancer lump will be removed.	The whole breast will be removed.

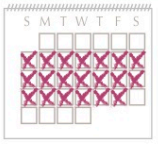
Early stage breast cancer: What's right for me?

picture option grid

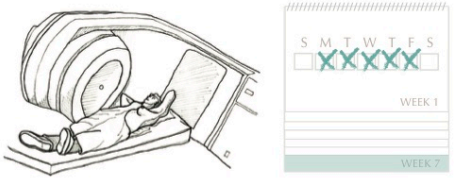
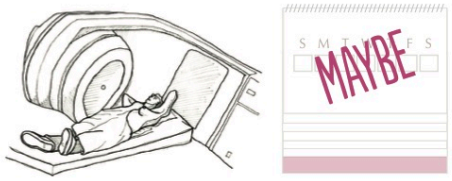
4. Will I need more than one surgery?

Lumpectomy with radiation	Mastectomy
	
Possibly, **20 in 100 women (20%)** might need additional surgery to remove more breast tissue or lymph nodes that have cancer.	**Possibly**, if your lymph nodes have cancer. **Yes**, if you choose breast reconstruction.

5. How long will it take me to recover?

Lumpectomy with radiation	Mastectomy
	
Most women are home on the same day as surgery	
...**but this may vary**. It will take about a week, or more, before you can resume usual activities.	...**or longer with reconstruction**. It will take several weeks, or longer, before you can resume usual activities.

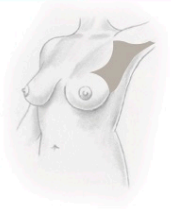
6. Will I need radiation in the breast?

Lumpectomy with radiation	Mastectomy
	
Yes, it will mean visits to the hospital **five days a week**, for up to **seven weeks** after surgery.	Radiation is **not usually given** after a mastectomy but may **sometimes** be recommended.

picture option grid

7. Will my lymph nodes be removed?

Lumpectomy with radiation	Mastectomy



Possibly, if cancer spreads to the lymph nodes under your arm. Your doctor will discuss with you whether you should consider further treatment such as surgery or radiotherapy.

8. Will I need chemotherapy and lose my hair?

Lumpectomy with radiation	Mastectomy

You may be offered chemotherapy, but this does not depend on the surgery you choose. Hair loss is common after chemotherapy.

9. How much will it cost?

Lumpectomy with radiation	Mastectomy

Both options have similar costs.
It is best to know what is covered by your insurance and what your out of pocket costs may be. Don't hesitate to ask your care team about this. They will know who can answer your questions.

Notes and questions

Now that you have looked at the Picture Option Grid, this page is for your notes, thoughts or any questions for you to discuss with your doctor.

1. Will it affect how long I live?

2. Will cancer come back in the breast?

3. What is removed in the breast?

4. Will I need more than one surgery?

5. How long will it take me to recover?

6. Will I need radiation in the breast?

7. Will my lymph nodes be removed?

8. Will I need chemotherapy and lose my hair?

9. How much will it cost?

Other questions/thoughts:

Early stage breast cancer: What's right for me?
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13 APPENDIX C. DECISION QUALITY WORKSHEET

DECISION QUALITY WORKSHEET FOR BREAST CANCER SURGERY

Instructions

This survey has questions about what it is like for you to make decisions about surgery for your early stage breast cancer.

Please circle the number (2) or check the circle ☑ to answer each item.

Your answers will tell us three important things:

1. What matters most to you?
2. How well are we doing our job of giving you information?
3. What do you talk about with your health care providers?

Thank you!

Here are some definitions of terms that appear in this survey:

Early stage breast cancer is breast cancer in stage I, IIA, IIB or IIIA. It means the cancer may have spread nearby to lymph nodes but not to other parts of the body.

Lymph nodes are small clusters of tissues that help defend the body from the spread of infections and cancer. The lymph nodes under the armpit are often checked to see whether breast cancer has spread.

Lumpectomy is surgery to remove only the breast tumor and a border of healthy tissue around it, saving the breast. Lumpectomy is also called breast conserving surgery.

Breast reconstruction is surgery to recreate a breast shape. The surgeon will use a breast implant, tissue from another part of your body (called flaps), or a combination.

Mastectomy is surgery to remove the entire breast.

Radiation therapy is the use of high-energy x-rays to kill cancer cells. Radiation is a local therapy used to kill cancer cells that may remain in the breast area after surgery.

Section 1: What Matters Most to You

This set of questions includes some reasons other women have given for choosing their breast cancer surgery. We are interested in what is important to you.

Please mark on a scale from 0 to 10, how important each of the following are to you as you are thinking about <u>your decision about surgery</u>.

How important is it to you to . . .

	Not at all important										Extremely important
1.1. keep your breast?	0	1	2	3	4	5	6	7	8	9	10
1.2. remove your entire breast to gain peace of mind?	0	1	2	3	4	5	6	7	8	9	10
1.3. avoid having radiation?	0	1	2	3	4	5	6	7	8	9	10
1.4. have reconstruction to make a breast shape?	0	1	2	3	4	5	6	7	8	9	10
1.5. avoid more surgery?	0	1	2	3	4	5	6	7	8	9	10

1.6. Is there anything else that is important to you that we have missed?

_____

1.7. At the moment, what option are you leaning towards to treat your early stage breast cancer?

- ○ Lumpectomy only
- ○ Lumpectomy and radiation
- ○ Mastectomy
- ○ Other surgery: _____
- ○ I am not sure

Section 2: Facts About Breast Cancer Surgery

We would like to check if we have done a good job at giving you information about breast cancer. Please answer the following questions using what you have read and heard from your care team so far.

2.1. For most women with early breast cancer, how much would waiting a few weeks to make a treatment decision affect their chances of survival?

- ○ A lot
- ○ Some
- ○ A little or not at all.

2.2. With treatment, about how many women diagnosed with early breast cancer will eventually die of breast cancer?

- ○ Most will die of breast cancer
- ○ About half will die of breast cancer
- ○ Most will die of something else

2.3. After which treatment is it more likely that women will need to have another operation to remove more tumor cells?

- ○ Lumpectomy
- ○ Mastectomy
- ○ Equally likely for both

2.4. On average, which women with early breast cancer live longer?

- ○ Women who have a mastectomy
- ○ Women who have a lumpectomy and radiation
- ○ There is no difference

2.5. On average, which women have a higher chance of having cancer come back in the breast that has been treated?

- ○ Women who have a mastectomy
- ○ Women who have a lumpectomy and radiation
- ○ There is no difference

Section 3: Talking With Health Care Providers

Please answer these questions about what happened when you talked with health care providers including doctors, nurses and other health care professionals about surgery for breast cancer. The two main options for surgery are mastectomy and lumpectomy and radiation (also called breast conserving surgery).

3.1. Did any of your health care providers talk about mastectomy as an option for you?

- ○ Yes
- ○ No

3.2. How much did you and your health care providers talk about the reasons to have a mastectomy?

- ○ A lot
- ○ Some
- ○ A little
- ○ Not at all

3.3. How much did you and your health care providers talk about the reasons **not** to have a mastectomy?

- ○ A lot
- ○ Some
- ○ A little
- ○ Not at all

3.4. Did any of your health care providers talk about lumpectomy and radiation as an option for you?

- ○ Yes
- ○ No

3.5. How much did you and your health care providers talk about the reasons to have a lumpectomy and radiation?

- ○ A lot
- ○ Some
- ○ A little
- ○ Not at all

3.6. How much did you and your health care providers talk about the reasons **not** to have a lumpectomy and radiation?

- ○ A lot
- ○ Some
- ○ A little
- ○ Not at all

3.7. Did any of your health care providers ask you which type of surgery you wanted, a lumpectomy or mastectomy?

- ○ Yes
- ○ No

14 APPENDIX D. SAMPLE CONSENT DOCUMENTS

14.1 Appendix D-1. Sample Information Sheet

How will you protect my privacy?

Protecting your privacy is important to us. Some of the information we collect could identify you. Information that could identify you will be treated as confidential.

None of the people treating you at your breast care clinic will be allowed to see the information collected that could identify you.

Certain members of the research team will be allowed to see information that identifies you.

The research team includes the study principal investigator plus others working on this study at this clinic and elsewhere.

We will store all information we collect on password-protected files and hard drives or in locked file cabinets. We will only transfer this information using secure methods.

It is possible for a court or government official to order the release of study data including information about you. There is only a small chance of this happening.

All information that could identify you will be removed before we analyze and share the data with others. Information collected in this study will be kept for six years after the study is over.

See the consent document for more information about protecting your privacy.

If you have other questions, please ask at any time.

Who can I contact?

If you have questions or concerns about this study or interview, you can contact:

The Dartmouth Institute for
Health Policy and Clinical Practice

Renata West Yen
What Matters Most Project Coordinator
renata.west.yen@dartmouth.edu
603.650.1494
(during business hours)

Marie-Anne Durand, PhD
What Matters Most Principal Investigator
marie-anne.durand@dartmouth.edu
603.653.0851
(during business hours)

If you have questions, concerns, complaints, or suggestions about research at Dartmouth College you can contact:

Office of the Committee for Protection of Human Subjects at Dartmouth College

63 South Main Street, Room 302
Hanover, NH 03755
603.646.6482
(during business hours)

THE Dartmouth INSTITUTE FOR HEALTH POLICY & CLINICAL PRACTICE GEISEL SCHOOL OF MEDICINE AT DARTMOUTH

This study is funded by a Patient Centered Outcomes Research Institute (PCORI) award (CDR-1511-32875).

WHAT MATTERS MOST

Choosing the Right
Breast Cancer Surgery for You

Study Information

The Dartmouth Institute
for Health Policy and Clinical Practice

Information about the What Matters Most Study

You have been invited to take part in a research study. It is up to you decide if you want to take part in the study.

What is research?

Research is a process to create new knowledge.

What is the purpose of this study?

We want to help women who have early-stage breast cancer make the very best choices about breast cancer treatment.

What is involved?

We will ask you to complete up to five short surveys on a computer or tablet, on paper, or over the phone. The surveys will be taken:

(a) before and after your first breast surgery appointment,
(b) 1-2 weeks after your surgery, and
(c) 3 months after your surgery.

The surveys will ask you about your breast cancer care. The surveys will also ask about your emotions after your cancer diagnosis.

You may be invited to take part in a survey one year after your surgery.

You may also be invited to take part in an interview three months after your surgery.

What are the benefits?

You may enjoy doing the surveys and giving feedback on your care. Women receiving healthcare in the future may benefit from what we learn in the study. You might not directly benefit from taking part.

What are the risks?

There are no physical risks. You might find some of the questions in the surveys or interview to be upsetting. If this happens, help will be available.

How many people will take part?

This is a large study. Four breast cancer centers across the US are involved. We expect that 1,100 women will take part in this study. We expect 275 of those women to take part at your clinic.

Will every woman have the same experience?

No. Each woman in the study will be put into one of three groups. Each group will be given the same information in different ways.

Do I have to take part?

No, you do not have to take part. It is your choice. Your medical care will not be affected. You can also stop taking part at any time during the study. If you stop taking part, the information we have already collected will continue to be used.

How do I know if I can take part?

Your care team thinks that you can take part. Your surgeon will confirm if you can take part based on your clinical information.

How long will it take?

Each survey should take you 5-10 minutes to complete. If you also do the interview, it is expected to take about 45 minutes.

Will anything be recorded?

Yes, we will audio record a small number of surgical appointments. You do not have to agree to this. If you take part in an interview, it will also be audio recorded.

The recordings will be put into words. All of your personal information will be removed. Once this happens, no one will know that you are the person in the recordings.

Can someone come with me?

Yes, you are welcome to have someone with you when taking the surveys or in the interview.

Will I be paid?

You will receive a $15 gift card after the first two surveys. You will receive $15 for every survey or interview you do after that. We will give you the gift card after you complete each survey or interview.

What will happen to the results of the study?

We will publish what we find in medical and health journals. We will present what we find at meetings. None of this information will identify you or your family. In 2020, the results will be on our website: www.mattersmoststudy.com.

14.2 Appendix D-2. Sample Consent Form

Participant Study ID Number: _____

Study Title: What Matters Most: Choosing the Right Breast Cancer Surgery for You

Principal Investigator: Marie-Anne Durand

Additional Information on Privacy Protection

Your participation in this study is entirely voluntary.

Who may use or see my health information?
By signing the consent document, you allow the research team to use your health information and give it to others involved in the research. The research team includes the study director plus others working on this study at Dartmouth-Hitchcock Medical Center. You also permit any health care provider holding health information needed for this study to give copies of your information to the research team.

The information collected for this study will be used by researchers at Dartmouth College and [FILL IN OUTSIDE STUDY SITE].

Your permission to use your health information for this study will not end until the study is completed. During this study, you and others who take part in the study may not have access to the study data. You may ask for study data once the study is over.

What if I decide not to give permission to use and share my personal health information?
If you do not allow use of your health information for this study, you may not take part in this study.

Additional Information on Randomization

In this randomized study, patients are put into groups and each group is given the same information in different ways. This helps us find out if one way to provide the information is better than another. In order to make sure the study is fair, doctors and researchers cannot choose which group you join. Patients are put into their group by chance (or randomized). Just as when a woman becomes pregnant she has an equal chance of having a boy or girl, a patient has an equal chance of being in any of the groups being compared in the study.

Additional Information on the Tools Being Used

Two of the researchers in the study, Drs. Marie-Anne Durand and Glyn Elwyn, have a financial interest in the decision-making tools used in this research and may benefit financially from commercialization of the tools.

WHAT MATTERS MOST

Participant Study ID Number: _____

CONSENT TO TAKE PART IN RESEARCH

	Please Initial Each Box
I confirm that I have read the information sheet dated 08 August 2017 (version 7) for the above, What Matters Most study, and have had the opportunity to ask questions and have had these questions answered satisfactorily.	☐
I understand that my participation is voluntary and that I am free to withdraw consent at any time, without giving reason.	☐
If necessary for the study, I agree to have my surgical consultation visit recorded.	☐
If I am selected for an interview, I agree to have my conversation about this study recorded.	☐
I agree to take part in the above study.	☐

_____

Participant's Signature and Date PRINTED NAME

_____

Researcher or Designee Signature and Date PRINTED NAME

15 APPENDIX E. TERMS OF REFERENCE

15.1 Appendix E-1. Community Advisory Board Terms of Reference

Community Advisory Board

Being a Member of the Community Advisory Board: What is Expected?

This document (often called a 'Terms of Reference') has been developed for the Community Advisory Board (CAB) of our study. The study aims to help women diagnosed with breast cancer choose the right breast cancer surgery. This study is funded by PCORI (Patient Centered Outcomes Research Institute).

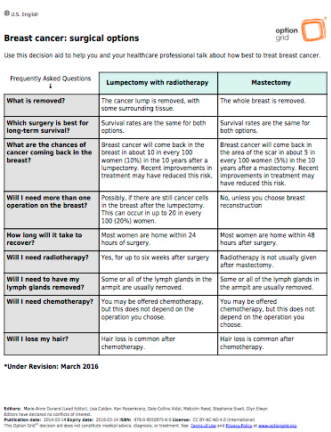
This document describes the format and goals of the CAB. It also describes your role, if you choose to become a CAB member.

What is the study about?

Nearly 1 in 8 women will develop breast cancer. Finding out about breast cancer is difficult and life changing for all women. However, breast cancer care, breast cancer treatments and the effect on women's lives are often worse for women of lower socioeconomic status (SES) and lower health literacy. Women of low SES are more likely to have lower knowledge of breast cancer surgery, to have a mastectomy, to regret their decision, and to have worse health outcome and care, compared to women of higher SES.

The study aims to understand how best to help women of low SES make high quality decisions about early stage breast cancer treatments. This means that their choice is informed by good knowledge, and by the things that matter most to them.

We will be comparing two decision aids used in the clinic visit, to usual care (what normally happens in the clinic).

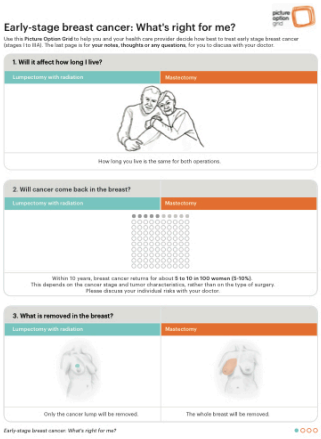


Breast cancer: surgical options

Use this decision aid to help you and your healthcare professional talk about how best to treat breast cancer.

Frequently Asked Questions	Lumpectomy with radiotherapy	Mastectomy
What is removed?	The cancer lump is removed, with some surrounding tissue.	The whole breast is removed.
Which surgery is best for long-term survival?	Survival rates are the same for both options.	Survival rates are the same for both options.
What are the chances of cancer coming back in the breast?	Breast cancer will come back in the breast in about 10 in every 100 women (10%) in the 10 years after a lumpectomy. Recent improvements in treatment may have reduced this risk.	Breast cancer will come back in the area of the scar in about 5 in every 100 women (5%) in the 10 years after a mastectomy. Recent improvements in treatment may have reduced this risk.
Will I need more than one operation on the breast?	Possibly, if there are still cancer cells in the breast after the lumpectomy. This can occur in up to 20 in every 100 (20%) women.	No, unless you choose breast reconstruction
How long will it take to recover?	Most women are home within 24 hours of surgery.	Most women are home within 48 hours after surgery.
Will I need radiotherapy?	Yes, for up to six weeks after surgery.	Radiotherapy is not usually given after mastectomy.
Will I need to have my lymph glands removed?	Some or all of the lymph glands in the armpit are usually removed.	Some or all of the lymph glands in the armpit are usually removed.
Will I need chemotherapy?	You may be offered chemotherapy, but this does not depend on the operation you choose.	You may be offered chemotherapy, but this does not depend on the operation you choose.
Will I lose my hair?	Hair loss is common after chemotherapy.	Hair loss is common after chemotherapy.

*Under Revision: March 2016



Early-stage breast cancer: What's right for me?

1. Will it affect how long I live?

Lumpectomy with radiation | Mastectomy

How long you live is the same for both operations.

2. Will cancer come back in the breast?

Lumpectomy with radiation | Mastectomy

3. What is removed in the breast?

Lumpectomy with radiation | Mastectomy

Only the cancer lump will be removed. | The whole breast will be removed.

Patients will be recruited from four hospitals:

- Joanne Knight Breast Health Center, St. Louis, MO;
- Bellevue Hospital Center, New York City, NY;
- Montefiore Medical Center, Bronx, NY;
- Dartmouth-Hitchcock Medical Center, Lebanon, NH.

We hope that the decision aids will help all women make better decisions. We also hope to show that women who have used the decision aids:

- Are involved in treatment decisions;
- Have lower anxiety;
- Have lower decision regret;
- Have higher quality of life;
- Perceive more coordination and integration of care compared to usual care.

We also hope to show that the Picture Option Grid can reduce disparities in decision making and treatment choice between women of high and low SES.

For more information about the study, see the scientific abstract in Appendix A. The study team will also share a copy of the study protocol with you, if you choose to become a CAB member.

We will use the ideas that have come from an approach called Community Based Participatory Research (CBPR) to run the study. This means that we will involve patients and community members in all aspects of the study.

What are the goals of the CAB?

The goal of the CAB is to capture your opinions, as a patient or community member.

In other words, the CAB members will represent the community participating in the study. In this project, the CAB members will represent women who have been diagnosed with early stage breast cancer, both of high and low SES.

The goal is to ensure that:

1. The study and materials are suitable to people who take part;
2. Eligible participants and local stakeholders know about the study;
3. The recruitment process works well;
4. The data collected in the study can answer the research questions;
5. The study results are communicated in a way that everyone understands.

The CAB will also include the patient associates who will recruit patients at each study site and the study patient partners. In total, the CAB will comprise 16 to 18 people.

One member of the CAB will be nominated by the group to attend all Trial Steering Group meetings and relay the CAB's discussion and action points. All four patient partners will also attend the Trial Steering Group meeting.

What will I have to do?

You will be asked to voice your opinions and experience about breast cancer surgery decisions with others. You will have access to the study website and study documents.

Specifically, you will be asked to:

a) Join virtual meetings

You will be asked to attend a 1-hour meeting every 3 months, for a duration of 3 years. This is a total of 4 meetings per year.

The first meeting will be held in February 2017 (exact date to be confirmed).

Over the course of the study (November 2016 - October 2019), you will be expected to join 12 meetings. You will join all meetings by phone.

b) Read study documents (before virtual meetings)

You will be asked to review study information sheets and questionnaires.

You will also be asked to read study reports and help produce other study documents.

c) Help us share the study findings

In 2019, we will have a meeting at each study site to share the results of the study. We will welcome your advice in organizing this event, and reaching out to a wide range of people.

d) Help us monitor the study progress and risks

We will let you know how the study is going every three months. We will ask for your advice if things go wrong.

What should I expect during the meeting?

The meetings will held on the phone, for one hour every three months.

You will need a telephone with a mute button and a quiet space. You should allow 5 minutes prior to the meeting to set up and dial in to the call.

You will also need access to a computer.

All meetings will be moderated by a member of the research team.

After each meeting, we will send you a summary of what was said by email, or in the mail if you prefer.

Will I receive payment for my involvement?

Yes, you will be paid $100 per hour. We expect you to attend a 1-hour telephone meeting four times a year (12 meetings in total).

We will also cover up to one hour of your time to read study documents before each meeting.

In total, we will cover 2 hours of your time, four times a year ($800 per year, for three years).

How long do I have to commit?

The study will last three years, starting in November 2016. We would value your involvement throughout all three years.

Scientific Abstract

Background and Significance

Breast cancer is the most commonly diagnosed malignancy in women. Despite improvements in survival, women of low socioeconomic status (SES) diagnosed with early stage breast cancer:
- Continue to experience poorer doctor-patient communication, lower satisfaction with surgery and decision making, and higher decision regret compared to women of higher SES;
- Often play a passive role in decision making;
- Are less likely to undergo breast-conserving surgery (BCS);
- Are less likely to receive optimal care.

Those differences are disparities that predominantly affect women of low SES with early stage breast cancer, irrespective of race or ethnicity. For early stage breast cancer, low SES is a stronger predictor of poorer outcomes, treatment received and death, than race or ethnicity. We define low SES as a lower income, lower educational attainment, and uninsured or state-insured status

Although BCS is the recommended treatment for early stage breast cancer (stages I to IIIA), research confirms equivalent survival between mastectomy and BCS. Both options are offered, yet have distinct harms and benefits, valued differently by patients. Our patient and stakeholder partners have emphasized the critical importance of supporting women in making high quality breast cancer surgery decisions (good knowledge and alignment between the patient's choice, values and priorities) irrespective of SES and health literacy. Yet, research shows that women of low SES are not usually involved in an informed, patient-centered dialogue about surgery choice. There is no evidence that women of low SES have distinct preferences that explain a lower uptake of BCS and limited engagement in decision making. Further, communication strategies are not typically adapted to women of low SES and low health literacy. Most decision aids for breast cancer have been designed for highly literate audiences, with poor accessibility and readability. Simpler, shorter, decision aids delivered in the clinical encounter (encounter decision aids) may be more beneficial to underserved patients, and could reduce disparities. It is critical to determine how to effectively support women of low SES in making informed breast cancer surgery choices.

Study Aims

First, we will assess the comparative effectiveness of two effective encounter decision aids (Option Grid and Picture Option Grid) against usual care on decision quality (primary outcome), shared decision making, treatment choice and other secondary outcomes across socioeconomic strata (Aim 1). Second, we aim to explore the effect of the Picture Option Grid on disparities in decision making (decision quality, knowledge and shared decision making), treatment choice, as well as mediation and moderation effects (Aim 2). Third, in order to maximize the implementation potential, we will explore strategies that promote the encounter decision aids' sustained use and dissemination using a theoretical implementation model (Aim 3).

Study Description

We will conduct a three-arm, multi-site randomized controlled superiority trial with stratification by SES (Aims 1 and 2) and randomization at the clinician level. One thousand patients (half of high SES and half of low SES) will be recruited from four large cancer centers. In preparation for the trial (Year 01), we will conduct semi-structured interviews with women of low SES who have completed treatment for early stage breast cancer (at three out of four participating sites), to adapt the "What Matters Most to You" subscale of the Decision Quality Instrument (DQI) for women of low SES. Lastly, we will use interviews, field-notes and observations to explore strategies that promote the interventions' sustained use and dissemination using the Normalization Process Theory (Aim 3). Community-Based Participatory Research will be used throughout the trial (with continuous patient and stakeholder involvement).

We will include all women between 18 and 75 years of age with a confirmed diagnosis of early stage breast cancer (I to IIIA) from both high and low SES, provided they have a basic command of the English, Spanish, or Mandarin Chinese language. We will recruit about 333 patients per arm.

Both interventions have been developed, tested and shown to be effective. The Option Grid (intervention 1) is a one-page evidence-based summary of available options presented in a tabular format, listing the trade-offs that patients normally consider when making breast cancer surgery decisions. The Picture Option Grid (intervention 2) uses the same evidence and tabular layout, but is tailored to women of low SES and low health literacy, and includes simple text and images. Because decision aids are not routinely available in real world settings, usual care is a coherent and legitimate comparator. It will include the provision of usual information resources about breast cancer but will exclude the provision of other decision aids.

The primary outcome measure is the 16-item validated DQI. Secondary outcome measures include CollaboRATE, a three-item validated measure of shared decision making, the eight-item validated PROMIS anxiety short form, the validated five-item Decision Regret scale, Chew's validated one item health literacy screening item, the validated 6-item quality of life measure EQ-5D-5L and the four-item measure of integration of health care delivery: IntegRATE. All measures will be available in English, Spanish, and Mandarin. Observer OPTION5 will be used to rate the level of shared decision making in the clinical encounter.

We will use a regression framework (logistic regression, linear regression, mixed effect regression models, generalized estimating equations) and mediation analyses. We will also use multiple informants analysis to measure and examine SES and multiple imputation to manage missing data. Heterogeneity of treatment effects analyses for SES, age, ethnicity, race, literacy, language, and study site will be performed.

15.2 Appendix E-2. DSMB Terms of Reference

Data and Safety Monitoring Board (DSMB)
Terms of Reference

Study: Comparative effectiveness of encounter decision aids for early stage breast cancer across socioeconomic strata
Principal Investigator: Marie-Anne Durand

Study Description

We aim to understand how best to help women of low socioeconomic status (SES) make high quality decisions about early stage breast cancer treatments (i.e., so their choice is informed by adequate knowledge, and aligned with their informed values and preferences). We will be comparing two effective decision aids used in the health care visit (an Option Grid and a Picture Option Grid) to usual care, in women of high SES and low SES. We hope that the decision aids help all women (irrespective of SES) achieve higher decision quality and a treatment choice that is informed by their knowledge and preferences. In addition, we also hope to demonstrate that women who have used the decision aids are meaningfully involved in treatment decisions, have lower anxiety, lower decision regret, higher quality of life, and perceive more coordination and integration of care compared to usual care. We also hope to show that the Picture Option Grid can reduce disparities in decision making and treatment choice between women of high and low SES.

See Appendix A for a copy of the technical abstract.

Roles and Responsibilities

The central goal of the Data and Safety Monitoring Board (DSMB) is to provide additional oversight for the trial, and assess the safety and efficacy of the study. The DSMB serves in an advisory role in making recommendations to the study staff.

The roles of the DSMB include the following:

- Review protocol prior to implementation.
- Review study data as it is collected, at regularly scheduled intervals for protocol adherence, safety, study conduct, scientific validity and integrity of the trial. This includes a data verification check that the appropriate outcome measures are given at the appropriate time points.
- Review the performance of study operations and other relevant issues, as necessary.
- Advise the Primary Investigator (PI) on any potential risks that arise in the study.
- Advise on any risk mitigation plans.

The DSMB is responsible for defining its deliberative processes and voting procedures, and maintaining the confidentiality of its internal discussions and content of all documents provided for review.

The DSMB must be satisfied with the timeliness, completeness and accuracy of the data submitted, in order to fulfill their roles, as listed above.

Items typically reviewed by the DSMB will include:

- Data quality, completeness and timeliness;
- Interim/cumulative data to identify potential adverse events;
- Interim/cumulative data to assess efficacy according to existing analysis plan (to be provided to DSMB members as part of trial protocol);
- Performance of each study site, according to recruitment targets pre-defined in protocol;
- Adequacy of compliance with recruitment and retention goals;
- Overall adherence to protocol;
- Factors that might compromise the study outcomes or confidentiality of the trial data.

The DSMB will conclude each review with their recommendation to the study PI and indicate if the study should be continued without change, be modified or terminated.

Frequency of Meetings

The DSMB will convene twice a year between November 2016 and October 2019, for a total of six meetings across three years, as follows (exact dates TBC):

1. April 2017
2. October 2017
3. April 2018
4. October 2018
5. April 2019
6. October 2019

Membership

The DSMB will include key stakeholders in the participating communities (one patient representative and breast surgeon) as well as academics with expertise in statistics, patient engagement in health care, breast cancer surgery and health disparities. Membership is voluntary and is not paid.

Conflict of Interest

No member of the DSMB should have direct involvement in the conduct of the study.

No member of the DSMB should have financial, proprietary, professional, or other interests that may affect impartial decision making by the DSMB.

Each member of the DSMB will need to complete a COI form, before attending the first DSMB meeeting.

At the start of each DSMB, the Chair will check that there are no new conflicts of interest to declare among the DSMB members.

Procedures

The biannual DSMB meetings will last up to three hours and will be held in person (or joined remotely on the phone) at the Williamson Translational Research Building, One Medical Center Drive, Lebanon, NH, 03766. Each meeting will include an open session, a closed session and an executive session.

During the meeting, the board will generate a report with their recommendations. The DSMB recommendations will be discussed with the PI as well as the Trial Steering Group, which meets quarterly. The Trial Steering Group will consider all DSMB recommendations and revise relevant aspects of the trial accordingly.

Meeting minutes from each DSMB meeting will be submitted to the funding agency (Patient Centered Outcomes Research Institute) for this study as part of the regular progress reports.

Appendix A

Background and Significance

Breast cancer is the most commonly diagnosed malignancy in women. Despite improvements in survival, women of low socioeconomic status (SES) diagnosed with early stage breast cancer:
- Continue to experience poorer doctor-patient communication, lower satisfaction with surgery and decision making, and higher decision regret compared to women of higher SES;
- Often play a passive role in decision making;
- Are less likely to undergo breast-conserving surgery (BCS);
- Are less likely to receive optimal care.

Those differences are disparities that predominantly affect women of low SES with early stage breast cancer, irrespective of race or ethnicity. For early stage breast cancer, low SES is a stronger predictor of poorer outcomes, treatment received and death, than race or ethnicity. We define low SES as a lower income, lower educational attainment, and uninsured or state-insured status.

Although BCS is the recommended treatment for early stage breast cancer (stages I to IIIA), research confirms equivalent survival between mastectomy and BCS. Both options are offered, yet have distinct harms and benefits, valued differently by patients. Our patient and stakeholder partners have emphasized the critical importance of supporting women in making high quality breast cancer surgery decisions (good knowledge and alignment between the patient's choice, values and priorities) irrespective of SES and health literacy. Yet, research shows that women of low SES are not usually involved in an informed, patient-centered dialogue about surgery choice. There is no evidence that women of low SES have distinct preferences that explain a lower uptake of BCS and limited engagement in decision making. Further, communication strategies are not typically adapted to women of low SES and low health literacy. Most decision aids for breast cancer have been designed for highly literate audiences, with poor accessibility and readability. Simpler, shorter, decision aids delivered in the clinical encounter (encounter decision aids) may be more beneficial to underserved patients, and could reduce disparities. It is critical to determine how to effectively support women of low SES in making informed breast cancer surgery choices.

Study Aims

First, we will assess the comparative effectiveness of two effective encounter decision aids (Option Grid and Picture Option Grid) against usual care on decision quality (primary outcome), shared decision making, treatment choice and other secondary outcomes across socioeconomic strata (Aim 1). Second, we aim to explore the effect of the Picture Option Grid on disparities in decision making (decision quality, knowledge and shared decision making),

treatment choice, as well as mediation and moderation effects (Aim 2). Third, in order to maximize the implementation potential, we will explore strategies that promote the encounter decision aids' sustained use and dissemination using a theoretical implementation model (Aim 3).

Study Description

We will conduct a three-arm, multi-site randomized controlled superiority trial with stratification by SES (Aims 1 and 2) and randomization at the clinician level. One thousand patients (half of high SES and half of low SES) will be recruited from four large cancer centers. In preparation for the trial (Year 01), we will conduct semi-structured interviews with women of low SES who have completed treatment for early stage breast cancer (at three out of four participating sites), to adapt the "What Matters Most to You" subscale of the Decision Quality Instrument (DQI) for women of low SES. Lastly, we will use interviews, field-notes and observations to explore strategies that promote the interventions' sustained use and dissemination using the Normalization Process Theory (Aim 3). Community-Based Participatory Research will be used throughout the trial (with continuous patient and stakeholder involvement).

We will include all women between 18 and 75 years of age with a confirmed diagnosis of early stage breast cancer (I to IIIA) from both high and low SES, provided they have a basic command of the English, Spanish, or Mandarin Chinese language. We will recruit about 333 patients per arm.

Both interventions have been developed, tested and shown to be effective. The Option Grid (intervention 1) is a one-page evidence-based summary of available options presented in a tabular format, listing the trade-offs that patients normally consider when making breast cancer surgery decisions. The Picture Option Grid (intervention 2) uses the same evidence and tabular layout, but is tailored to women of low SES and low health literacy, and includes simple text and images. Because decision aids are not routinely available in real world settings, usual care is a coherent and legitimate comparator. It will include the provision of usual information resources about breast cancer but will exclude the provision of other decision aids.

The primary outcome measure is the 16-item validated DQI. Secondary outcome measures include CollaboRATE, a three-item validated measure of shared decision making, the eight-item validated PROMIS anxiety short form, the validated five-item Decision Regret scale, Chew's validated one item health literacy screening item, the validated 6-item quality of life measure EQ-5D-5L and the four-item measure of integration of health care delivery: IntegRATE. All measures will be available in English, Spanish, and Mandarin. Observer OPTION5 will be used to rate the level of shared decision making in the clinical encounter.

We will use a regression framework (logistic regression, linear regression, mixed effect regression models, generalized estimating equations) and mediation analyses. We will also use multiple informants analysis to measure and examine SES and multiple imputation to manage

missing data. Heterogeneity of treatment effects analyses for SES, age, ethnicity, race, literacy, language, and study site will be performed.

16 APPENDIX F. DSMB Charter

Data and Safety Monitoring Board (DSMB) Charter

Study Title: What Matters Most: Choosing the Right Breast Cancer Surgery for You

Scientific Title: Comparative effectiveness of encounter decision aids for early stage breast cancer across socioeconomic strata

Name of Sponsor	Patient Centered Outcome Research Institute (PCORI)
ClinicalTrials.gov ID	NCT03136367
Protocol Number	Protocol v1.8
Name of Principal Investigator	Marie-Anne Durand
Date of Charter	28 March 2017

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1 Introduction

An independent Data and Safety Monitoring Board (DSMB) has been convened to assess the progress of the What Matters Most study, its safety data, and critical efficacy endpoints (if appropriate) and to provide recommendations to PCORI.

The members of the DSMB serve in an individual capacity and provide their expertise and recommendations. The DSMB will review cumulative study data to evaluate safety, study conduct, scientific validity, and data integrity of the study.

This Charter will outline the roles and responsibilities and serve as the Standard Operating Procedure (SOP) for the DSMB.

The What Matters Most study aims to understand how best to help women of low socioeconomic status (SES) make high quality decisions about early stage breast cancer treatments (i.e., so their choice is informed by adequate knowledge and aligned with their informed values and preferences). Two effective decision aids used in the health care visit (an Option Grid and a Picture Option Grid) will be compared to usual care, in women of high SES and low SES (see Scientific Abstract in Appendix A).

2 Composition of the DSMB

The Committee will be composed of seven members (inclusive of the DSMB Chair). The DSMB includes experts in or representatives of the fields of shared decision making, breast cancer surgery, patient advocacy, statistics and clinical trials methodology. Membership is voluntary and is not paid.

Members of the DSMB are:

1. **David Goodman, MD, MS**, Chair of DSMB (Professor of Pediatrics, of Community and Family Medicine and of the Dartmouth Institute for Health Policy and Clinical Practice, Dartmouth College, Lebanon, NH)
2. **Susan Z. Berg, MS**, Patient Representative with expertise in shared decision-making (Program Director at the Center for Shared Decision Making, Dartmouth-Hitchcock Medical Center, Lebanon, NH)
3. **Cindy B. Matsen, MD,** board member with expertise in breast cancer surgery (fellowship-trained breast surgeon, University of Utah, Huntsman Cancer Center, Salt Lake City, UT)
4. **Todd A. MacKenzie, PhD**, board member with expertise in biostatistics and clinical trials methodology (Professor of Biomedical Data Science, Dartmouth College, Lebanon, NH)

5. **Samir Soneji, PhD**, board member with expertise in healthcare disparities and progress and value of cancer care (Assistant Professor of The Dartmouth Institute for Health Policy and Clinical Practice, Dartmouth College, Lebanon, NH)
6. **Nan Cochran, MD**, board member expertise in communication in healthcare (Associate Professor of Medicine, Dartmouth College, Lebanon, NH)
7. **Robin Paradis Montibello, MLIS**, DSMB Executive Secretary with experience in SDM research (Preference Laboratory Coordinator, The Dartmouth Institute for Health Policy and Clinical Practice, Dartmouth College, Lebanon, NH)

If a member misses a meeting, the Chair should ensure the member is available for the subsequent meeting. If a member misses a second meeting, the Chair should ask the member about his or her ability to remain on the DSMB. If a third meeting is missed, the member should be replaced.

Each member will serve a term of three years (duration of the study).

3 Independence of the DSMB

It is essential that the judgment of members of the DSMB not be influenced by factors other than those necessary to maintain subject safety and to preserve the integrity of the study. No members of the DSMB should have financial, proprietary, professional or other interests that may affect impartial decision making by the DSMB. Independence is essential to ensure that the DSMB members are objective and capable of an unbiased assessment of the study's safety and efficacy data. The following will ensure the independence of the DSMB:

- Members of the DSMB will not participate as investigators in the study under review and will not be supervised by study investigators.
- Members of the DSMB must not have a direct interest in knowing or influencing trial outcome or have a financial, proprietary, or intellectual interest in the outcome of the study under review.
- DSMB members must disclose all potential new conflicts of interests (COIs) .

Each member of the DSMB will need to complete a COI form before attending the first DSMB meeting.

The DSMB Chair will be responsible for deciding whether consultancies or the disclosed interests of the members materially affect their objectivity.

Members of the DSMB will be responsible for notifying the DSMB Chair of any changes in conflicts of interest, including consultancies. In such cases, the DSMB meeting minutes will document the disclosure of the potential conflict of interest and the outcome of the discussion (e.g., abstention of member from voting, recusal from discussion). The DSMB Chair will decide whether any of these relationships results in a conflict of interest which would preclude

involvement on the DSMB. Members of the DSMB who develop potential or significant perceived conflicts of interest will be asked to resign from the DSMB. Members will be polled at the beginning of each DSMB meeting to disclose whether status has changed.

4 Responsibilities of the DSMB

4.1 Objectives

The central goal of the Data and Safety Monitoring Board (DSMB) is to provide additional oversight for the trial and to assess the safety and efficacy of the study. The DSMB serves in an advisory role in making recommendations to the study staff.

4.2 General Responsibilities

The general responsibilities of the DSMB are:

- Review protocol prior to implementation.
- Review study data at regularly scheduled intervals for protocol adherence, safety, study conduct, scientific validity, and integrity of the trial. This includes a data verification check to ensure that the appropriate outcome measures are given at the appropriate time points.
- Review the performance of study operations and other relevant issues, as necessary.
- Advise the Primary Investigator (PI) on any potential risks that arise in the study.
- Advise on any risk mitigation plans.
- Review data on subject withdrawals including the reason for withdrawal and subject anxiety scores.

The DSMB is responsible for defining its deliberative processes and voting procedures and for maintaining the confidentiality of its internal discussions and content of all documents provided for review.

The DSMB must be satisfied with the timeliness, completeness, and accuracy of the data submitted in order to fulfill their roles, as listed above.

Items typically reviewed by the DSMB will include:

- Data quality, completeness, and timeliness;
- Interim/cumulative data to identify potential adverse events;
- Interim/cumulative data to assess efficacy according to the existing analysis plan (to be provided to DSMB members as part of trial protocol);
- Performance of each study site, according to recruitment targets pre-defined in protocol;
- Adequacy of compliance with recruitment and retention goals;
- Overall adherence to protocol;
- Factors that might compromise the study outcomes or confidentiality of the trial data.

The DSMB will conclude each review with their recommendation to the study PI and indicate if the study should be continued without change, be modified, or be terminated.

5 DSMB Chair Responsibilities

The following responsibilities are those of the DSMB Chair:

- Serve as a voting member;
- Facilitate the meetings, advise on the content of the agenda, and ensure that the meeting minutes and recommendation(s) are appropriately documented;
- Serve as the primary contact person for the DSMB;
- Review and approve the Charter;
- Ensure that those involved in the day-to-day management of the study are excluded from DSMB voting procedures;
- Discuss DSMB recommendations with the PI;
- Review, sign, and approve DSMB minutes (taken by the DSMB executive secretary).

6 PI Responsibilities

The study PI is responsible for:

- Preparing a summary of DSMB recommendations to be sent to each participating IRB (during active phase of research study only);
- Submitting DSMB meeting minutes or meeting summaries with follow-up plans to the DSMB members within one month of the DSMB meeting.
- Informing PCORI and the IRB(s) of DSMB recommendations in a timely manner. If there are adverse or unanticipated events/problems to report, PCORI and the IRB(s) will be notified immediately following the DSMB meeting. If there are no adverse or unanticipated events/problems to report, DSMB meeting minutes and recommendations will be communicated to PCORI in the interim progress report.

7 Meetings of the DSMB

Each meeting will consist of three sessions: Open Session, Closed Session, and Closed Executive Session.

7.1 Organizational Meeting

The first meeting of the DSMB will be an organizational meeting. This meeting will formally establish the DSMB and begin to acquaint the DSMB members with the protocol that this DSMB will be charged with monitoring. It affords the DSMB an opportunity to recommend final

revisions to the Charter and the communication plan between the DSMB, the study team, the IRB(s), and PCORI.

The attendees for this organizational meeting will include DSMB members and representatives from PCORI in the open session only.

Meeting objectives will include:

- The introduction of the DSMB;
- Review of the DSMB Charter;
- Review of the study protocol;
- Agreement on the procedures for conducting business (e.g., voting rules and quorum, attendance, etc.).

7.2 Open Session

This will begin with an introductory session that includes a roll call, a reminder about the confidential nature of the proceedings and corresponding documentation, and a review of conflict of interest for all DSMB members.

Following the introductory session, the DSMB will move into the open session. Attendees will include all DSMB members, both voting and *ex officio*, the PI, the study statistician, other relevant study staff personnel, and PCORI staff members.

The open session will serve as a general study update. The PI and study statistician (as relevant) will be called upon to present study status and known relevant findings. Others with specific safety experience or concerns may also be called upon to present. The session will provide a forum for an exchange of information among the various groups involved in the conduct of the study. It will afford the DSMB members an opportunity to question the project team about the study and to seek additional information deemed relevant to the data review. Discussions may include progress of the study, including adverse events, disease status of participants, comparability of groups with respect to baseline factors, protocol compliance, site performance, quality control, and timeliness and completeness of follow-up. Only masked data will be reviewed and/or discussed during the open session.

7.3 Closed Session

Following the open session of the meeting, a closed session involving the DSMB members will be held to review grouped safety data and, if appropriate, review efficacy data, discuss findings, develop recommendations, and obtain agreement on voting. The study data may be presented by the study statistician, as needed. During this session, any issues related to subject safety will be discussed. Requests by the DSMB members for the unmasking of data may be made at this time. Interim efficacy analysis planned *a priori* will be addressed in this closed session. This session is normally attended only by the voting members, study statisticians, and invited *ex*

officio members. The DSMB may invite the participation of other individuals for all or part of the session.

7.4 Closed Executive Session

This final session involves only the DSMB voting members to ensure complete objectivity as they discuss outcome results, make decisions, and formulate recommendations regarding the study. If treatment codes have been made accessible to the DSMB, then the DSMB may unmask the data based on procedures identified in advance.

7.5 Unscheduled Meetings/Reports

Unscheduled meetings can be requested by any party with the responsibility of overseeing the study. Requests can be made to the DSMB Chair or PI. The Chair, in collaboration with the PI, will schedule any unplanned meetings.

The DSMB may request special reports on an as needed basis. These requests will be made to the study team.

8 Communication

This DSMB will meet via teleconference call and in person at the Williamson Translational Research Building, DHMC, Lebanon, NH. An agenda will be provided detailing the items and documents to be discussed. It is estimated that the meeting will be scheduled for up to three hours.

8.1 Reports to the DSMB

Associated Adverse Events (AEs) and Serious Adverse Events (SAEs) of special interest will be provided to the DSMB in advance of each meeting or as requested by the DSMB.

Study documents will be provided to the DSMB at least one week prior to each scheduled meeting.

8.2 DSMB Minutes

The minutes will be taken by the DSMB executive secretary.

The DSMB executive secretary will prepare the draft meeting minutes of the open session only and recommendations and forward them to the DSMB Chair for review within one (1) week following the DSMB meeting. For confidentiality reasons, the minutes of the closed and

executive sessions will not be circulated. However, the recommendations (arising from the closed and executive sessions) will be included in the minutes.

The minutes, after Chair approval, will be forwarded to the study PI. The study PI will return those minutes within two weeks of the meetings to the Chair and Secretary with follow-up plans. The minutes with follow-up plans will be circulated to all DSMB members by the DSMB executive secretary.

8.3 Recommendations

A brief summary that describes the individual findings, overall safety assessment, and DSMB recommendations will be agreed upon by the Chair and forwarded to the PI within one week of the meeting as part of the minutes.

The DSMB can recommend to the PI to continue the current study without modification, continue with specified modifications, discontinue one or more study arms, or halt or modify the study until more information is available.

The PI will be responsible for sharing and discussing those recommendations with PCORI, IRB(s) and with the trial steering group in a timely manner. If there are adverse or unanticipated events/problems to report, PCORI, the IRB(s) and the trial steering group will be notified immediately following the DSMB meeting. If there are no adverse or unanticipated events/problems to report, DSMB meeting minutes and recommendations will be communicated to PCORI in the interim progress report, and to the trial steering group at their next scheduled meeting. The Trial Steering Group will consider all DSMB recommendations and revise relevant aspects of the trial accordingly.

Meeting minutes from each DSMB meeting will be submitted to the funding agency as part of the regular progress reports.

9 Revisions to the Charter

A draft of the Charter will be provided to the DSMB prior to the first DSMB meeting. During the first meeting, this Charter will be reviewed and revised as needed. The Chair and PCORI will approve all changes to the Charter. The version date will be displayed as a header on all pages.

As needed, the Charter may be revised after the first meeting, with the Chair and PCORI providing sign-off.

Changes to the Charter will be clearly delineated in a document, and this document will be associated with the new version.

10 Completion of DSMB Activities

The DSMB will remain active until the end of the study.

APPENDIX A: Scientific Abstract

Background and Significance

Breast cancer is the most commonly diagnosed malignancy in women. Despite improvements in survival, women of low socioeconomic status (SES) diagnosed with early stage breast cancer:

- Continue to experience poorer doctor-patient communication, lower satisfaction with surgery and decision making, and higher decision regret compared to women of higher SES;
- Often play a passive role in decision making;
- Are less likely to undergo breast-conserving surgery (BCS);
- Are less likely to receive optimal care.

Those differences are disparities that predominantly affect women of low SES with early stage breast cancer, irrespective of race or ethnicity. For early stage breast cancer, low SES is a stronger predictor of poorer outcomes, treatment received and death, than race or ethnicity. We define low SES as a lower income, lower educational attainment, and uninsured or state-insured status

Although BCS is the recommended treatment for early stage breast cancer (stages I to IIIA), research confirms equivalent survival between mastectomy and BCS. Both options are offered, yet have distinct harms and benefits, valued differently by patients. Our patient and stakeholder partners have emphasized the critical importance of supporting women in making high quality breast cancer surgery decisions (good knowledge and alignment between the patient's choice, values and priorities) irrespective of SES and health literacy. Yet, research shows that women of low SES are not usually involved in an informed, patient-centered dialogue about surgery choice. There is no evidence that women of low SES have distinct preferences that explain a lower uptake of BCS and limited engagement in decision making. Further, communication strategies are not typically adapted to women of low SES and low health literacy. Most decision aids for breast cancer have been designed for highly literate audiences, with poor accessibility and readability. Simpler, shorter decision aids delivered in the clinical encounter (encounter decision aids) may be more beneficial to underserved patients, and could reduce disparities. It is critical to determine how to effectively support women of low SES in making informed breast cancer surgery choices.

Study Aims

First, we will assess the comparative effectiveness of two effective encounter decision aids (Option Grid and Picture Option Grid) against usual care on decision quality (primary outcome), shared decision making, treatment choice and other secondary outcomes across socioeconomic strata (Aim 1). Second, we aim to explore the effect of the Picture Option Grid on disparities in decision making (decision quality, knowledge, and shared decision making), treatment choice, as well as mediation and moderation effects (Aim 2). Third, in order to maximize the implementation potential, we will explore strategies that promote the encounter

decision aids' sustained use and dissemination using a theoretical implementation model (Aim 3).

Study Description

We will conduct a three-arm, multi-site randomized controlled superiority trial with stratification by SES (Aims 1 and 2) and randomization at the clinician level. One thousand, one hundred patients (half of higher SES and half of lower SES) will be recruited from five large cancer centers. In preparation for the trial (Year 01), we will conduct semi-structured interviews with women of low SES who have completed treatment for early stage breast cancer (at three out of four participating sites), to adapt the "What Matters Most to You" subscale of the Decision Quality Instrument (DQI) for women of low SES. Lastly, we will use interviews, field-notes, and observations to explore strategies that promote the interventions' sustained use and dissemination using the Normalization Process Theory (Aim 3). Community-Based Participatory Research will be used throughout the trial (with continuous patient and stakeholder involvement).

We will include women between 18 and 75 years of age with a confirmed diagnosis of early stage breast cancer (I to IIIA) from both higher and lower SES, provided they have a basic command of English, Spanish, or Mandarin. We will recruit about 367 patients per arm.

Both interventions have been developed, tested, and shown to be effective. The Option Grid (intervention 1) is a one-page evidence-based summary of available options presented in a tabular format, listing the trade-offs that patients normally consider when making breast cancer surgery decisions. The Picture Option Grid (intervention 2) uses the same evidence and tabular layout, but is tailored to women of lower SES and low health literacy and includes simple text and images. Because decision aids are not routinely available in real world settings, usual care is a coherent and legitimate comparator. It will include the provision of usual information resources about breast cancer but will exclude the provision of other decision aids.

Secondary outcome measures will include treatment choice, the validated 3-item CollaboRATE measure of shared decision-making (SDM), Chew's validated one-item health literacy screening question, PROMIS, an 8-item validated anxiety short form, EQ-5D-5L, a validated, standardized 6-item quality of life measure, and four items from COST, a validated financial toxicity measure. We will also ask participants to estimate their out-of-pocket expenses over the past month. All measures will be available in English, Spanish, and Mandarin. Observer OPTION[5] will be used to rate the level of shared decision making in the clinical encounter.

We will use a regression framework (logistic regression, linear regression, mixed effect regression models, generalized estimating equations) and mediation analyses. We will also use multiple informants analysis to measure and examine SES and multiple imputation to manage missing data. Heterogeneity of treatment effects analyses for SES, age, ethnicity, race, literacy, language, and study site will be performed.